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J. CARTY
BLDG. 95

TECHNICAL MANUAL

PULSE GENERATOR

MODEL B7D

COMPUTER MEASUREMENTS
CMC
A DIVISION OF NEWELL INDUSTRIES

COMPUTER MEASMTS

TECHNICAL MANUAL

PULSE GENERATOR

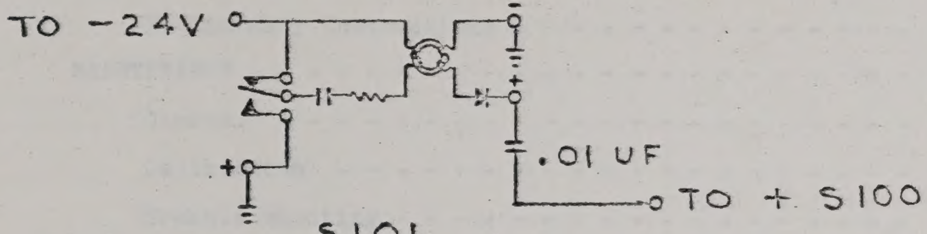
MODEL B7D

COMPUTER MEASUREMENTS/A DIVISION OF NEWELL INDUSTRIES
SAN FERNANDO, CALIFORNIA 91342

OPTION 14, B7D

BUILT-IN SINGLE-PULSE OPERATION

For the Model B7D Pulse Generator, add pushbutton switch (one shot) CMC Part No. 5140001. Add capacitor (qty 1), cer. disc, 0.01 μf, 500 v, CMC Part No. 4001103.



S101
SINGLE SHOT SWITCH
(FRONT PANEL)

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PULSE GENERATOR

MODEL B7D

GENERAL DESCRIPTION

The model B7D is a compact, lightweight, general purpose pulse generator designed to meet the rigid requirements of a great number of research and test applications. Exacting design criteria, an electron tube complement of a small number of tube types, and special duty cycle limiting circuitry to automatically protect the output tubes from life-shortening overloads insure long periods of reliable operation with a minimum of maintenance and repair problems.

The model B7D simultaneously produces two trains of 50 volt pulses (positive and negative polarity) having repetition rates from 20 cycles per second to 2 megacycles per second, pulse delays and widths to 10,000 microseconds, rise and fall times which are separately and independently controllable at the front panel from 15 nanoseconds to approximately one (1) microsecond and a permissible duty factor of up to 30% at full amplitude.

The model B7D generates these pulse trains in the following manner. (Refer to Fig. A for time relations of the various pulses.)

The oscillator section creates a continuous train of timing pulses to establish the repetition rate of the output pulse. These timing pulses are used to start delay circuitry to produce what we shall call a start pulse. The start pulse occurs at the end of a time predetermined by the pulse delay controls. The start pulse is used to form the leading edge of the output pulse and to start another delay circuit which produces a second pulse called the stop pulse. This stop pulse occurs at the end of a time predetermined by the setting of the pulse width controls and is used to form the trailing edge of the output pulse. A clamp tube, which is cut off at the time the start pulse occurs, and back on again when the stop pulse occurs, creates what is used as a fill-in pulse between the start and stop pulses. The basic output pulse is therefore created by turning the main pulse on with the start pulse, keeping it on with the fill-in pulse, and turning it off with the stop pulse.

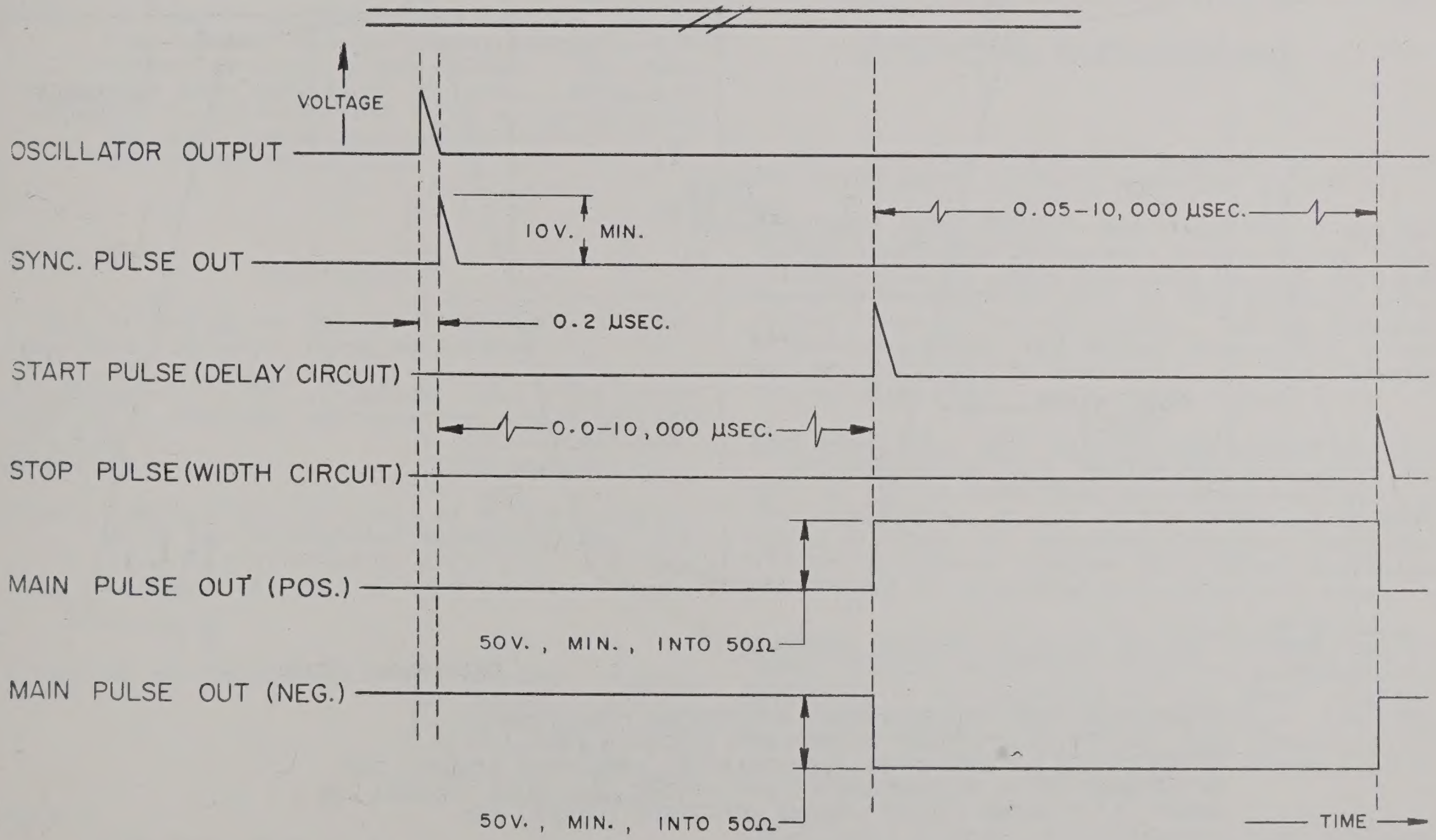


FIG. A TIMING DIAGRAM

The pulse forming circuitry then amplifies the power of this pulse and presents it through suitable attenuation and polarity determining circuitry as the main output pulse.

Supplementary circuitry furnishes a synchronizing pulse from the oscillator section for use in synchronizing additional instrumentation with the main output pulse of the generator, a means of triggering the generator from a external source so that it may be synchronized with other instruments, and a means of varying the rise and fall times of the output pulse for applications requiring a degraded pulse shape.

Past experience has indicated confusion concerning the definition of some of the basic terminology used in reference to pulses. Fig. B shows these terms as defined by accepted IRE standard pulse terminology. When used in this manual, these terms are meant to be as defined by this standard.

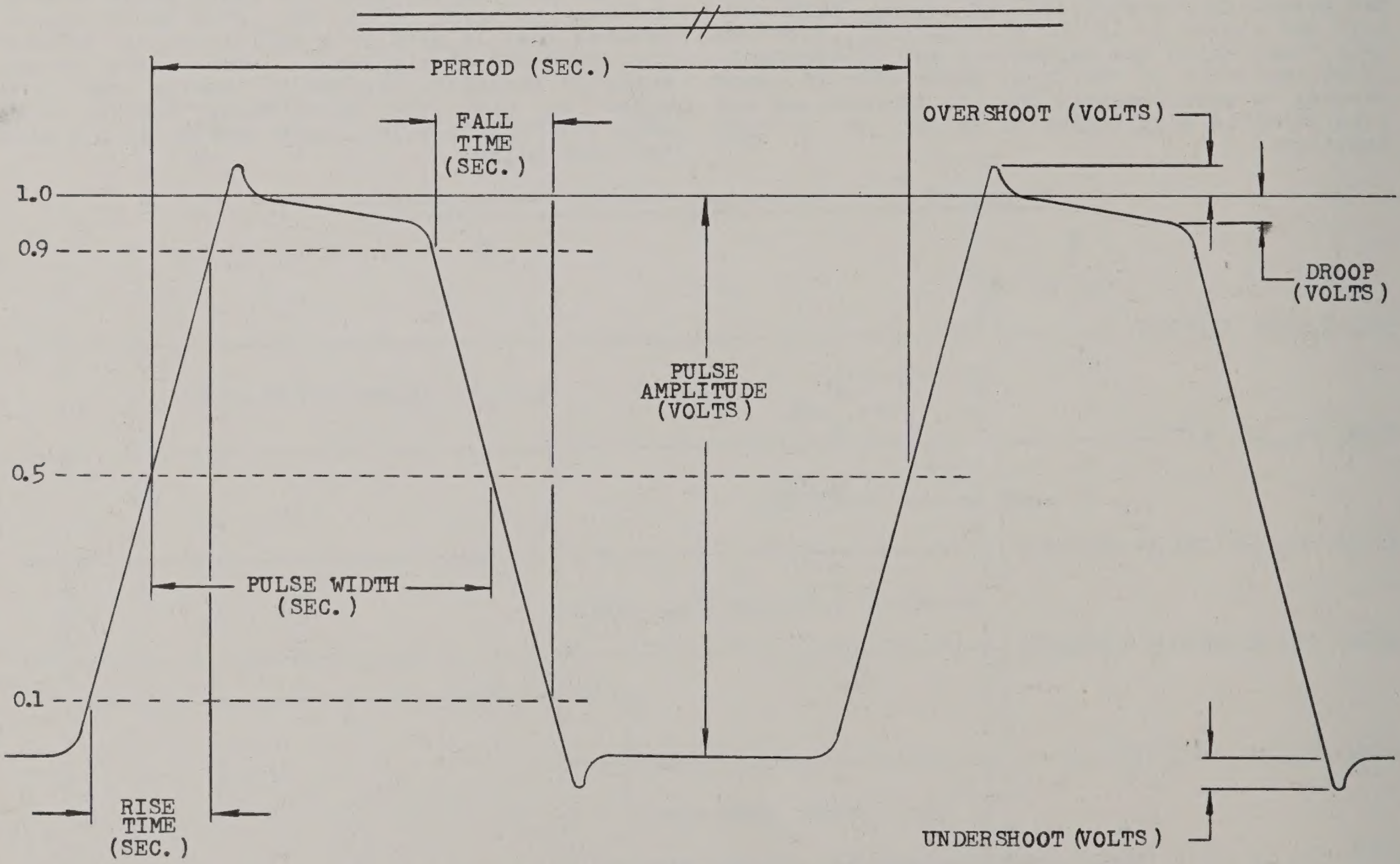
SPECIFICATIONS

The following are the design specifications of the model B7D pulse generator. The instrument will, in most cases, exhibit properties which are superior to the specifications.

OSCILLATOR REPETITION RATE

The internal oscillator is continuously variable from 20 cycles per second to 2 megacycles per second in five ranges.

20 cps - 200 cps
200 cps - 2 kc
2 kc - 20 kc
20 kc - 200 kc
200 kc - 2 mc



REPETITION RATE (PULSES/SEC.) = 1/PERIOD (SEC./PULSE)
DUTY FACTOR (%) = PULSE WIDTH (SEC.)/PERIOD (SEC.) 100
OVERSHOOT (%) = OVERSHOOT (VOLTS)/PULSE AMPLITUDE (VOLTS) 100
UNDERSHOOT (%) = UNDERSHOOT (VOLTS)/PULSE AMPLITUDE (VOLTS) 100
DROOP (%) = DROOP (VOLTS)/PULSE AMPLITUDE (VOLTS) 100

FIG. B DEFINITIONS OF BASIC PULSE TERMINOLOGY

PULSE DELAY

Main pulse delay for both polarity outputs is continuously variable, with respect to the sync pulse out, from 0.0 microseconds to 10,000 microseconds in five ranges.

0.0 µsec. - 1.0 µsec.
1.0 µsec. - 10 µsec.
10 µsec. - 100 µsec.
100 µsec. - 1,000 µsec.
1,000 µsec. - 10,000 µsec.

PULSE WIDTH

Main pulse width for both polarity outputs is continuously variable from 0.05 microseconds to 10,000 microseconds in five ranges.

0.05 µsec. - 1.0 µsec.
1.0 µsec. - 10 µsec.
10 µsec. - 100 µsec.
100 µsec. - 1,000 µsec.
1,000 µsec. - 10,000 µsec.

TRIGGER REQUIRED

To trigger the unit from an external source, the following trigger pulse is required.

AMPLITUDE	20V., minimum.
REPETITION RATE	2 mc, maximum.
RISE TIME	1.0 µsec. or less.
POLARITY	Positive or negative.

NOTE: At lower repetition rates and/or faster rise times, the instrument triggers with a much lower amplitude pulse. The fast rise time quality of the sync. pulse out allows the model B7D to be triggered from the sync. pulse from another model B7D at all repetition rates.

MAIN PULSE

The following are the specifications of the main output pulses. (Both polarities)

AMPLITUDE	50V., minimum, into a 50Ω load.
POLARITY	Positive and negative simultaneously
RISE TIME	0.015 microseconds.
FALL TIME	0.015 microseconds.

NOTE: Rise and/or fall times of either polarity pulse may be degraded separately and independently without affecting the remaining rise and fall times.

OVERSHOOT AND UNDERSHOOT	5%, maximum, except when pulse is attenuated more than 30db. with the 10db. step attenuator. 30%, maximum, at 50db. down.

DROOP:

0-100 µsec. wide pulse	Negligible.
100-1,000 µsec. wide pulse	15%, maximum.
1,000-10,000 µsec. wide pulse	25%, maximum.

DUTY FACTOR	30%, maximum, at full amplitude.

NOTE: Since the duty factor limiting circuitry is operated by the negative output pulse channel, it is important that the negative output be terminated in an external load of 50 ohms at all times in order to properly protect the output tubes.

ATTENUATION	0 to 60db., continuously variable.
OUTPUT IMPEDANCE	50Ω
DC LEVEL	The DC level of either output pulse may be set to zero at any duty factor up to 30% by front panel control.

SYNC PULSE OUT

The following sync. pulse is available at a front panel connector.

AMPLITUDE	10V., minimum.
WIDTH	0.05 µsec., minimum.
RISE TIME	0.03 µsec., maximum.
POLARITY	Positive.

MISCELLANEOUS SPECIFICATIONS

The following are miscellaneous specifications of the instrument.

POWER REQUIRED	115V., 4.0 amps., 50-60 cps, 460 watts.
VENTILATION	Forced air.
DIMENSIONS	19" X 8 3/4" X 18 5/8".
WEIGHT, NET	58 lbs.
WEIGHT, SHIPPING	70 lbs.
ACCESSORIES INCLUDED	One Instruction Manual.

OPERATING INSTRUCTIONS

Refer to Fig. C for the location of all of the front panel controls described below.

FREQUENCY RANGE SWITCH When operated in the internal oscillator positions rotary switch S110 switches timing capacitors C110 through C119 in the grid circuits of V11 to determine the frequency range of the oscillator. In the external trigger position, the switch applies the external trigger pulse to the grid of the Schmitt trigger tube, V12.

FINE FREQUENCY AND TRIGGER SENSITIVITY CONTROL Potentiometer R115 varies the voltage at the grid of V11 to determine the repetition rate of the oscillator on any of the frequency ranges. During periods of external trigger operation this potentiometer becomes the trigger sensitivity control to determine the triggering level.

EXTERNAL TRIGGER POLARITY SWITCH In the two external trigger positions, positive or negative, depending on the polarity of the input signal, the switch selects the positive pulse from the external trigger tube, V10A, and transfers it through S110 to the input of the Schmitt trigger tube, V12.

DELAY RANGE SWITCH Rotary switch S200 switches timing capacitors C200 through C204 in the grid to ground circuit of V20A to determine the range of pulse delay.

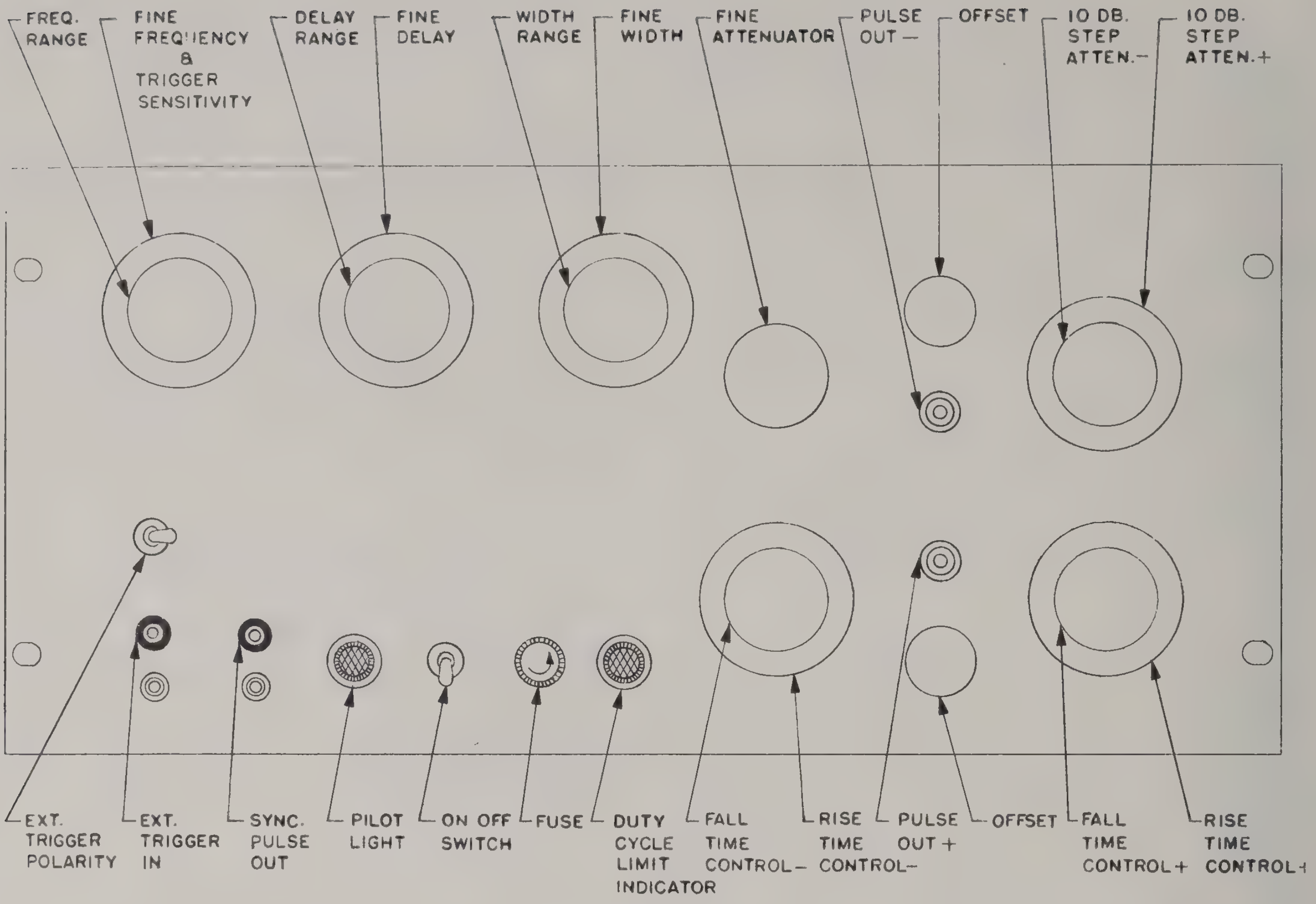


FIG. C

FINE DELAY CONTROL   Potentiometer R208 varies the cathode to ground resistance of the pulse delay multivibrator, affording continuous delay settings on all delay ranges.

WIDTH RANGE SWITCH   Rotary switch S300 switches timing capacitors C300 through C304 in the grid to ground circuit of V30A to determine the range of pulse width.

FINE WIDTH CONTROL·   Potentiometer R308 varies the cathode to ground resistance of the pulse width multivibrator, affording continuous width settings on all width ranges.

10db. STEP ATTENUATOR (NEG.)   Rotary switch S800 controls the amplitude of the negative output pulse in 10db. steps.

10db. STEP ATTENUATOR (POS.)   Rotary switch S801 controls the amplitude of the positive output pulse in 10db. steps.

FINE ATTENUATOR CONTROL   Potentiometer R531 affords a continuously variable attenuation through each range of the 10db step attenuators.

RISE TIME CONTROL (NEG. PULSE)   Potentiometer R411 varies the resistance in the control grids of the negative pulse output tubes, V45 and V46. Degradation of the negative pulse rise time is accomplished independently of the fall time and has no influence on rise or fall time of the positive pulse.

RISE TIME CONTROL (POS. PULSE)   Potentiometer R413 varies the resistance in the control grids of the positive pulse output tubes, V48 and V49. Degradation of the positive pulse rise time is accomplished independently of the fall time and has no influence on rise or fall time of the negative pulse.

FALL TIME CONTROL (NEG. PULSE)   Potentiometer R410 varies the resistance in the control grids of the negative pulse output tubes, V45 and V46. Degradation of the negative pulse fall time is accomplished independently of the rise time and has no influence on rise or fall time of the positive pulse.

FALL TIME CONTROL (POS. PULSE)   Potentiometer R412 varies the resistance in the control grids of the positive pulse output tubes, V48 and V49. Degradation of the positive pulse fall time is accomplished independently of the rise time and has no influence on rise or fall time of the negative pulse.

NOTE: Independent rise and fall time control is accomplished by use of solid state diodes in a back-to-back arrangement working in conjunction with a capacitance network. (See schematic)

EXTERNAL TRIGGER IN J100 couples an external trigger through C100 to the control grid of the external trigger amplifier, V10A.

SYNC. PULSE OUT J101 takes the synchronizing pulse from the cathode of the sync. pulse cathode follower, V10B.

PILOT LIGHT Lamp I500 lights when 115V. AC, 50-60 cps, single phase power is applied to the power transformer, T500.

ON-OFF SWITCH Switch S500 applies power to the primary winding of the power transformer, T500.

FUSE 5 ampere "slo-blo" fuse F500 protects the pulse generator from overloads.

DUTY CYCLE LIMITING INDICATOR Lamp I530 lights when the 30% duty factor limitation is exceeded. This lamp, when lit, is a warning to the operator that the amplitudes of the output pulses are being automatically reduced.

NOTE: Since the duty factor limiting circuitry is operated by the negative output pulse channel, it is important that the negative output be terminated in an external load of 50 ohms at all times in order to properly protect the output tubes.

MAIN PULSE OUT (NEG.) Coaxial connector J102 takes the negative main output pulse from the output of its 10db step attenuator.

MAIN PULSE OUT (POS.) Coaxial connector J103 takes the positive main output pulse from the output of its 10db step attenuator.

DC OFFSET CONTROL (NEG.) Potentiometer R858 varies the grid voltage of V55 to enable setting the DC level of the negative pulse to zero at all duty factors up to 30%.

DC OFFSET CONTROL (POS.) Potentiometer R862 varies the grid voltage of V56 to enable setting the DC level of the positive pulse to zero at all duty factors up to 30%.

DUTY CYCLE LIMIT ADJUST (Rear Panel Adjustment) Potentiometer R602 sets the operating level of a variable voltage regulator section in the power supply. The setting of this adjustment determines the point at which the Duty Cycle Limit Indicator Light, I530 will glow and the point at which the amplitude of the output pulse begins to be reduced automatically in order to protect the output tubes.

PRELIMINARY INSTRUCTIONS

VENTILATION The model B7D pulse generator is cooled by forced air. It is imperative that both ends of the instrument be kept free of obstructions at all times in order to insure adequate air flow.

It is inadvisable to operate the instrument for appreciable lengths of time with the dust covers removed. These covers not only help to keep the instrument free from dust and other foreign matter, but also properly direct the flow of air through the instrument. Therefore, if the end covers are removed and the instrument mounted in a rack, the dust cover sections must be replaced before rack mounting.

DUTY FACTOR LIMITATION The dissipation limitations of the 6DQ5 power amplifier tubes limit the duty factor of the model B7D pulse generator to 30%, i.e., at full pulse amplitude, the pulse width must never equal greater than 30% of the pulse to pulse spacing. Operation up to approximately 70% duty factor is possible with reduced pulse amplitude.

The 30% duty factor limitation is automatically controlled in the model B7D. Should the duty factor limitation be exceeded, the model B7D automatically reduces the amplitude of the outputs to such a level that the ratings of the output tubes are not exceeded. When the duty cycle limiter is in operation, the duty cycle lamp on the front panel lights, warning the operator of the reduced pulse amplitude condition.

FIRST TIME OPERATION The following procedure is recommended for putting the instrument into operation for the first time.

1. Turn the power switch to "OFF" and connect the line cord to a source of 115V., 50-60 cps power.

2. Set the instrument controls as follows:

a.	Frequency Range	200 kc
b.	Frequency	100 kc
c.	Delay Range	1 μsec.
d.	Delay	0 μsec.
e.	Width Range	10 μsec.
f.	Width	1 μsec.
g.	10db Step Attenuators	0 db.
h.	Fine Attenuators	0 db.
i.	Rise Time Controls	clockwise
j.	Fall Time Controls	clockwise

3. Connect an oscilloscope as follows:

a.	Sweep	1 μsec./cm
b.	Vertical Deflection	20 V./cm
c.	Trigger	External from the sync. out connector on the model B7D front panel.

4. Connect a ground strap from one of the model B7D ground binding posts to a ground binding post on the oscilloscope.

5. Connect a 50Ω resistive load between a pulse out connector and ground. The output impedance of the model B7D is 50Ω and it is imperative that it be properly terminated if the true output waveform is to be observed.

6. Connect the input probe of the oscilloscope across the 50Ω external load. If

the true waveform of the output pulse is to be observed, it is imperative that the oscilloscope input probe be properly compensated for viewing step function waveforms by adjusting the compensating capacitor in the probe itself and that the probe ground strap be connected to the instrument ground.

7. Turn the model B7D power switch to "ON" and allow approximately one (1) minute for the instrument to reach operating temperature. Adjust the trigger sensitivity of the oscilloscope for a stable trace. The model B7D controls may now be set to any desired values within the 30% duty factor limitation.

MAINTENANCE INSTRUCTIONS

DANGER

The power supplies in this instrument operate at voltages which are dangerous to personnel. Extreme caution must be exercised at all times. Repair or maintenance work should never be attempted unless competent personnel, thoroughly trained in the accepted methods of artificial respiration, are in attendance.

DANGER

The following maintenance suggestions are designed to aid the maintenance technician in scheduling regular preventative as well as corrective maintenance routines. It is important that maintenance routines be performed regularly to obtain maximum life and usefullness from the instrument.

FAN MOTOR The fan motor bearings require oil periodically. Use a good grade of light machine oil and apply only a drop or two every six months.

CLEANING THE INSTRUMENT At regular intervals, any dust that has settled on the interior of the instrument should be removed by means of dry compressed air. AVOID high velocity air streams which might injure the instrument or disturb adjustments. Persistent dirt may be removed with a lint-free cloth and, if necessary, carbon tetrachloride.

Under normal conditions, the silver plated contacts of the rotary switches should not require special attention. In case they become tarnished, the contacts should be cleaned by rotating the switch several times.

INSPECTION A visual inspection for loose or broken wiring, loose hardware, and discolored or deformed components is desirable while the instrument is being cleaned.

SWITCHES Turn the rotary switches while observing the contacts to check contact centering in each index position. Improperly centered contacts may be due to the switch becoming warped or twisted. AVOID pressure on the contacts as they are easily damaged.

CAPACITORS AND RESISTORS Inspect the electrolytic capacitors for leakage of electrolyte. Replace if necessary. The wax coating of the paper tubular capacitors may drip if the instrument has been overheated by operation in a restricted space. This condition usually does not indicate replacement.

Composition resistors should be checked for serious discoloration which would indicate excessive dissipation and, therefore, faulty operation. A moderate amount of discoloration is normal.

RACK MOUNTING The model B7D, as purchased, is a portable instrument. It may, however, be mounted in a rack with other instrumentation by removing the louvered end panels. To remove the end panels, first remove both sections of the dust cover. The six sheet metal screws which hold each louvered end panel to the inner end panels are now accessible. Remove these screws and the two screws which hold each end panel to the front panel. Replace both dust covers on the instrument and it is ready for rack mounting. The dust covers must be put back on the instrument before rack mounting as they not only serve to keep dust and other foreign matter out of the instrument, but also help to properly direct the flow of cooling air through the instrument.

CALIBRATION The model B7D contains several controls for the purposes of calibration, pulse shape adjustment, etc. These controls are preset at the factory and should not require readjustment except due to component aging or when electron tubes are replaced.

When readjustment of these controls becomes necessary, the instrument should be allowed to operate for one hour prior to adjustment in order that all components may reach their normal operating temperatures and the instrument has reached maximum stability.

The calibration and checkout chart shown on the following page is patterned after the checkout procedure used at the factory. The chart is intended as a calibration aid only and presupposes that the instrument is in proper working order, except for calibration. It should be noted that there is some interaction between many of the controls. Therefore, it is recommended that the complete calibration and check procedure, working from top to bottom of the chart, be performed at one time on a periodic basis rather than spot adjustments to one circuit which could conceivably have adverse effect on another. Note that an asterisk (*) in any one column indicates that it does not matter which position that control is in for that particular check.

All of the controls used for calibration and adjustment are called out by schematic symbol number on the chassis or circuit board on which they are located, with the following exceptions:

C118 is mounted on the repetition rate switch

C204 is mounted on the delay switch

C304 is mounted on the width switch

R602 is adjustable through the access hole at the rear of the instrument.

TO CHECK OR CALIBRATE			MODEL B7D DIAL SETTINGS											OSCILLOSCOPE SETTINGS		OBSERVE	ADJUST	REMARKS
			REP. RATE		DELAY		WIDTH		ATTENUATOR		POLARITY		RISE TIME					
			RANGE	VERNIER	RANGE	VERNIER	RANGE	VERNIER	STEP	VERNIER	OUTPUT	TRIGGER	CONTROL	VERTICAL	HORIZONTAL			(*) + or -
REP. RATE	20~-200~ 200 -2KC 2KC-20KC 20KC-200KC	HIGH END	200~-2KC	20	1	1	10	5	0	CW	*	*	CW	20V/cm	0.1millisec/cm	0.5 millisec Pulse to pulse	R111	There is some interaction between the high and low controls. Therefore, these two adjustments should be readjusted several times until both are correct. Adjustment of this range automatically adjusts the other three ranges.
		LOW END	200~-2KC	2	1	1	100	5	0	CW	*	*	CW	20V/cm	1 millisec/cm	5 millisec Pulse to pulse	R116	
	200KC-2MC		200KC-2MC	20	1	MIN	1	MIN	0	CW	*	*	CW	20V/cm	0.1µsec/cm	0.5µsec Pulse to pulse	C118	This adjustment is to be made only after the four lower ranges have been calibrated.
	EXTERNAL TRIGGER	POSITIVE	EXT. TRIG.	SEE REMARKS	1	MIN	SEE REMARKS		0	CW	*	+	CW	20V/cm	SEE REMARKS	One output pulse for each trigger in.	NONE	Use any input trigger from 20~ to 2MC rep. rate, 20V amplitude, and rise time less than 1µsec. Oscilloscope horizontal settings and B7D width setting will depend on rep. rate. Adjust B7D rep. rate vernier for reliable triggering.
		NEGATIVE	EXT. TRIG.	SEE REMARKS	1	MIN	SEE REMARKS		0	CW	*	-	CW	20V/cm	SEE REMARKS	One output pulse for each trigger in.	NONE	
	SYNC PULSE	AMPLITUDE	200KC-2MC	20	1	MIN	1	MIN	0	CW	*	*	CW	10V/cm	0.1µsec/cm	10V. Minimum	NONE	Looking at pulse at the sync. out jack on the instrument front panel. Polarity of the sync. pulse is positive.
		WIDTH														Approx .05µsec		
		RISE TIME														Approx .03µsec		
PULSE DELAY	1-10 10-100 100-1,000 1,000-10,000		2KC-20KC	2	10	10	1	10	0	CW	*	*	CW	20V/cm	1µsec/cm	10µsec. - leading edge of sync pulse to leading edge of output pulse.	R200	Adjustment of this range also adjusts the three remaining longer ranges.
	0 to 1		20KC-200KC	2	1	10	1	MIN	0	CW	*	*	CW	20V/cm	0.1µsec/cm	1µsec. - leading edge of sync pulse to leading edge of output pulse.	C204	This adjustment is to be made only after the four longer ranges have been calibrated. Note that when the delay vernier is CCW the output pulse occurs coincident with or before the sync. pulse.
PULSE WIDTH	1-10 10-100 100-1,000 1,000-10,000		2KC-20KC	2	1	MIN	10	10	0	CW	*	*	CW	20V/cm	1µsec/cm	10µsec. - leading edge to trailing edge of output pulse at 50% amplitude points.	R300	Adjustment of this range also adjusts the three remaining longer ranges.
	0.05 to 1		20KC-200KC	2	1	MIN	1	10	0	CW	*	*	CW	20V/cm	0.1µsec/cm	1µsec. - leading edge to trailing edge of output pulse at 50% amplitude points.	C304	This adjustment to be made only after the four longer ranges have been calibrated. Note that when the width vernier is CCW the pulse width is 0.05µsec. or less.
OUTPUT PULSE	AMPLITUDE	POSITIVE NEGATIVE	20~-200~	2	1	MIN	10,000	8	0	CW	+	*	CW	20V/cm	1 millisec/cm	SEE REMARKS	R479 R473	Increase the adjustment until the amplitude of the output pulse near the trailing edge stops increasing and the leading edge starts to peak. Decrease the adjustment until the peaking just disappears.
	PULSE SHAPE	SHORT PULSE	20KC-200KC	2	1	MIN	1	5	0	CW	+	*	CW	20V/cm	0.1µsec/cm	SEE REMARKS	C260 C360 C472	Set C472 for best possible overall pulse shape. Adjust C260 and C360 for improvement. Finally, slight readjustment of all three controls will optimize the pulse shape.
		LONG PULSE	2KC-20KC	2	1	MIN	10	10	0	CW	+	*	CW	20V/cm	10µsec/cm	SEE REMARKS	C350 R354	Adjust R354 for minimum droop. Adjust C350 for optimum flatness of pulse top. Finally, slight readjustment of both controls will optimize long pulse shape.
	ATTENUATOR	10db STEP	2KC-20KC	2	1	MIN	10	10	0	CW	+	*	CW	SEE REMARKS	1µsec/cm	SEE REMARKS	NONE	The step attenuator dial should be rotated to the various dial settings while noting that pulse amplitude decreases accordingly. Change the oscilloscope vertical setting as the attenuator is changed. At high attenuation settings, good grounding between instrument and oscilloscope becomes extremely important.
		VERNIER	2KC-20KC	2	1	MIN	10	10	0	SEE REMARKS	+	*	CW	20V/cm	1µsec/cm	SEE REMARKS	SEE REMARKS	Turn attenuator vernier CCW until the output pulse decreases 10db. Pulse flatness is pre-adjusted at the factory at this setting with R353. Note, however, that R353 may be adjusted for optimum flatness at any fine attenuator (0 to 10db down) or pulse width setting. Recheck the R354 setting.
	DUTY FACTOR		20KC-200KC	10	1	MIN	10	3	0	CW	+	*	CW	20V/cm	1µsec/cm	SEE REMARKS	R602	Adjust R602 to the point that pulse amplitude just starts to decrease and the duty cycle lamp on the front panel lights.
	RISE TIME	FASTEST	20KC-200KC	2	1	MIN	1	MIN	0	CW	+	*	CW	20V/cm	0.02µsec/cm	0.015µsec or less	NONE	Rise and fall times will appear to be greater than 0.015µsec. when viewed on an inferior oscilloscope. The Tektronix type N sampling unit is recommended for direct viewing of actual rise and fall times.
		DEGRADED	20KC-200KC	2			10	5					CCW		1µsec/cm	Approx 1µsec		
	FALL TIME	FASTEST	20KC-200KC	2	1	MIN	1	MIN	0	CW	+	*	CW	20V/cm	0.02µsec/cm	0.015µsec or less	NONE	
		DEGRADED	20KC-200KC	2			10	5					CCW		1µsec/cm	Approx 1µsec		

CALIBRATION AND CHECK CHART MODEL B7D

TROUBLE SHOOTING It is of extreme importance that the operation, theory, and physical location of components be thoroughly understood before any repair of the instrument is undertaken. A careful study of the circuit descriptions and the schematic diagram will, in most instances, indicate the cause for a particular difficulty in a much shorter time than will a blind point to point check of the entire instrument. It is also suggested that whenever an operational difficulty is encountered, a recheck of the setting and adjustment of the operational controls will often times reveal that a control has been inadvertantly set in the wrong position and that this is the cause of the difficulty.

ELECTRON TUBE FAILURE A major cause of equipment failure is weak or inoperative electron tubes. When a system failure has been traced to a particular circuit, it will be found expedient to test the electron tubes in that circuit, replacing all weak or inoperative ones, before a more detailed examination of the circuit is undertaken. A HICKOCK #539A Tube Checker has been found very satisfactory in detecting electron tubes with low transconductance.

ISOLATION OF THE DEFECTIVE CIRCUIT The following trouble shooting procedure is designed to isolate the trouble to one particular circuit.

Complete failure of the instrument to operate indicates a power source difficulty. Check the source of power and make certain that the power cord plug is firmly in place. Check the fuse on the instrument front panel. A blown fuse indicates an overload condition within the instrument. Blown fuses should not be indiscriminately replaced without first ascertaining the cause of overload, as further damage is likely to result.

If power is applied to the instrument but it still fails to operate, a check should be made of the power supply voltages. For this and subsequent checks, it will be necessary to remove the dust covers from the instrument.

It will be necessary to use a synchroscope for further checks. It is important that a synchroscope with a wide band-pass be used as it is impossible to observe many of the fast rise times and narrow pulse widths on an inferior synchroscope. The Tektronix models 517, 541, 543, or 545 have been found satisfactory in observing the waveforms present in the instrument.

If the instrument has no output pulse, check for a sync. pulse at the sync. out jack on the instrument front panel. If there is no sync. pulse, the trouble is in the oscillator section of the instrument. If, however, a sync. pulse is present, synchronize a synchroscope with this pulse and proceed as follows.

Check for a pulse at the input of the attenuator switch, S800. A pulse here isolates the trouble to the switch or its components. If no pulse or a deformed pulse is present, check for a pulse at pins 3 and 6 of V40. If a normal pulse is present at this point, the faulty circuitry is in the output section.

If no pulse is present at the cathodes of V40, the trouble will probably be found in the delay multivibrator or blocking oscillator. If, however, a deformed pulse is present, a study of its shape will be helpful in quickly finding its cause.

If the deformed pulse shows a very slow rise time and normal fall time, the start pulse is missing. Check the start pulse channel. If there are very narrow pulses where the leading and trailing edges of the output pulse would normally be, the clamp circuit is inoperative. If the pulse rises normally and then immediately starts to decay slowly toward zero, the trouble lies in the clamp circuit or the width multivibrator circuit. Finally, if the pulse is normal except for a slow fall time, check the stop pulse channel for faulty operation.

In checking each subsection, it is advisable to start by looking for an output pulse from the section and then work back toward the start of the section. Thus, whenever a normal pulse is found, the trouble is isolated to the stage which immediately follows it.

CIRCUIT DESCRIPTION

OSCILLATOR SECTION The oscillator section consists of the external trigger amplifier, V10A; the free-running multivibrator, V11; the Schmitt trigger, V12; the repetition rate blocking oscillator, V13; and the sync. pulse cathode follower, V10B. V10, V11, V12, and V13 are type 6DJ8 dual triode electron tubes.

The repetition rate of the free-running multivibrator is determined by the action of two front panel controls. The range of the oscillator is determined by the selection of timing capacitors C110 through C119, in the grid circuits of V11, by the oscillator range switch, S110. Fine repetition rate control of the multivibrator, through any range, is determined by varying the fine frequency potentiometer, R115, which varies the voltage to this grid circuit.

The limits of repetition rate for each range are set with the two calibration potentiometers, R111 and R116, which establish the range through which this voltage may vary.

The output, taken from the plate of the multivibrator triggers the Schmitt trigger circuit. The Schmitt trigger circuit shapes the pulse, and sends it to the repetition rate blocking oscillator.

The repetition rate blocking oscillator again shapes the pulse. The basic repetition rate timing pulse is taken from the cathode of this blocking oscillator and is used to trigger the delay multivibrator.

The external trigger amplifier provides a means of triggering the instrument from an external source. The external trigger polarity switch, in either the positive or negative position, depending on the polarity of the input signal, couples the positive pulse from V10A through the repetition rate range switch, S110, to the input grid of the Schmitt trigger. Potentiometer R115 now becomes a trigger sensitivity control to set the triggering level. It should be noted that the repetition rate switch, S110, must be placed in the external trigger position in order to trigger the model B7D from an external source.

The timing pulse taken from the cathode of the repetition rate blocking oscillator is also coupled through a 0.2 µsec. delay line to the grid of the sync. pulse cathode follower. The pulse taken from the cathode is brought to the instrument front panel to be used as a synchronizing pulse for use with other instrumentation. Due to the fact that the sync. pulse occurs approximately 0.2 µsec. after the pulse which triggers the pulse delay circuit, we are able to overcome the inherent delay of the remaining circuitry and can thus produce output pulses which are not delayed in time with respect to the sync. pulse.

DELAY SECTION The delay section consists of the delay multivibrator, V20, and the delay blocking oscillator, V21. V20 is a type 6DJ8 dual triode electron tube and V21 is a type 6BQ7A dual triode electron tube.

The monostable multivibrator, V20, is triggered from its stable state to its quasi-stable state by positive pulses from the oscillator section which are coupled into the grid of V20B and the plate of V20A through diode CR201. The length of time which the multivibrator remains in this quasi-stable state, determined by the timing capacitor in the grid circuit of V20A and the cathode to ground resistance of V20, is the delay time of the circuit. Thus, this circuit determines the time between the oscillator section timing pulse and the start of the main pulse.

The range of delay is determined by the selection of timing capacitors C200 through C204 by the delay range switch, S200. Fine delay control throughout any range is determined by varying the cathode to ground resistance with the fine delay potentiometer, R208.

R200 sets the voltage to which the grid circuit is returned, thus providing calibration for the various ranges.

A pulse, created by the return of the multivibrator to its stable state after this predetermined delay, is coupled from the plate of V20B to trigger the delay blocking oscillator, V21.

The pulse taken from the cathode of the blocking oscillator is known as the "start pulse". This start pulse goes to the amplifiers in the start channel and to the width section where it is used to trigger the width multivibrator.

WIDTH SECTION The pulse width section consists of the width multivibrator, V30. V30 is a type 6DJ8 dual triode electron tube.

The monostable multivibrator, V30, is triggered from its stable state to its quasi-stable state by positive pulses from the delay section which are coupled into the grid of V30B and the plate of V30A through diode CR301. The length of time which the multivibrator remains in this quasi-stable state, determined by the timing capacitor in the grid circuit of V30A and the cathode to ground resistance of V30, is the delay time of this circuit. Thus, this circuit determines the time between the delay section output pulse which starts the main pulse and the width section output pulse which stops the main pulse.

The range of pulse width, is determined by the selection of timing capacitors C300 through C304 by the width range switch, S300. Fine width control throughout any range is determined by varying the cathode to ground resistance with the fine width potentiometer, R308.

R300 sets the voltage to which the grid circuit is returned, thus providing calibration for the various ranges.

Two outputs are taken from the width multivibrator. The first is the waveform taken from the plate circuit of V30B. This waveform is a negative going pulse equal in time duration to the delay time of the width multivibrator. It is coupled through C310 to the grid of the clamp tube, V35B. The second output, a pulse created by the return of the multivibrator to its stable state after the predetermined delay, is known as the "stop pulse". This stop pulse is coupled into the amplifiers in the stop channel.

START PULSE CHANNEL The start pulse channel consists of three pulse shaping amplifier stages and the leading edge forming tube. V25 and V26 are type 7119 dual triode electron tubes. V27 is a type 6BQ7A dual triode electron tube.

The start channel receives the positive start pulse from the delay section through a 0.02 microsecond delay line, DL210. This delay line delays the start pulse without delaying the stop pulse, thus allowing a minimum output pulse width of 0.05 microseconds. This pulse goes through three pulse transformer coupled amplifier stages; V25A, V25B, and V26. Pulse transformer T260 couples the amplified pulse into the grids of the leading edge forming tube, V27. This tube drives the output pulse cathode follower, in the pulse forming section, to form the leading edge of the output pulse.

STOP PULSE CHANNEL The stop pulse channel consists of three pulse shaping amplifier stages and the trailing edge forming tube. V35A is ½ of a type 6BQ7A dual triode electron tube. V36 and V37 are type 7119 dual triode electron tubes.

The stop channel receives the positive stop pulse from the width section. It is sent through three stages of transformer coupled amplification; V35A, V36A, and V36B, into the grids of the trailing edge forming tube, V37. This tube drives the output pulse cathode follower, in the pulse forming section, to form the trailing edge of the output pulse.

OUTPUT SECTION The output section consists of a clamp tube, V35B, the pulse forming cathode follower, V40; two pairs of power amplifier tubes, V45 and V46 for negative pulse amplification and V48 and V49 for positive pulse amplification. In the negative pulse channel V47A acts as the grid restoration diode and V47B as the screen grid disconnect diode. Similarly, in the positive pulse channel V54A acts as the grid restoration diode and V54B as the screen grid disconnect diode. Electron tube V35B is ½ of a type 6BQ7A dual triode, V40 is a type 7119 dual triode, V45, V46, V48, and V49 are type 6DQ5 power pentodes, and V47 and V54 are type 6DJ8 dual triodes.

The clamp tube receives its input from the plate circuit of V30B in the pulse width section. During the period between output pulses, it conducts fully, holding the output at the zero level. Between the start and stop pulses it is completely cut off by the signal from the width multivibrator and holds the output pulse at full amplitude.

The grids of the pulse forming cathode follower are driven positive by the leading edge forming tube, held there by the clamp tube, and driven back to their original level by the trailing edge forming tube. From the cathodes of this tube, we take the fully shaped output pulse. This pulse is coupled through the rise time control circuitry to the control grids of the power amplifiers.

One pair of power amplifiers, V48 and V49, connected in parallel, acts as a cathode follower for a positive pulse out while a second pair of power amplifiers, V45 and V46 act as an inverting amplifier for a negative pulse out. The positive pulse out is delivered to a step attenuator which permits control of its output amplitude via S801. Similarly, the negative pulse out is delivered to a step attenuator which permits control of its output amplitude via S800.

Triode V47A, connected as a diode, provides restoration at the control grids of the negative pulse output tubes. The restoration level is adjusted by potentiometer R473. V47B, as connected, acts as the screen grid disconnect for the negative pulse output amplifiers.

Similarly, in the positive channel, triode V54A, connected as a diode, provides restoration at the control grids of the positive pulse output tubes. The restoration level is adjusted by potentiometer R479. V54B, as connected, acts as the screen grid disconnect for the positive pulse output amplifiers.

Finally, the negative and positive output pulses are sent to their respective step attenuators, S800 and S801, each consisting of five 10db. constant impedance T-sections, and to the pulse output jacks, J102 and J103 which are located on the instrument front panel.

POWER SUPPLY SECTION The power supply section contains the power transformer, T500; V50, a type OA2 voltage regulator tube; V51, a type 6AS7GA dual triode electron tube; V52, a type 12AX7 dual triode electron tube; V53, a type 6U8 triode-pentode electron tube, and their associated circuitry which includes two controls for varying the amplitude of the output pulse.

The power supply section furnishes five unregulated DC voltages (+250V., -4V., -8V., -18V., and -24V.), three regulated voltages (+150V., -150V., and a positive variable voltage), and two sets of voltages for use in the output amplifiers. For the positive output pulse amplifier it furnishes +150V. and -150V. and for the negative output pulse amplifier it furnishes -150V. and -300V. It also furnishes filament power for all of the electron tubes in the unit.

The +150V. supply is regulated by the action of V51A and V52A. The -150V. supply is regulated by the action of the voltage regulator tube, V50.

The positive variable voltage, used in two places; as plate supply for the last stage of start pulse amplification and as plate supply for the clamp tube; furnishes a means of varying the amplitude of the output pulse. This supply is regulated by the action of V51B and V52B. Its reference, however, is set by V53B.

This reference may be varied in two ways. First, it may be varied by varying the fine attenuator, R531. Secondly, it may be varied by the action of the duty cycle limiting control consisting of the circuitry of T600 and V53A.

Transformer T600 senses the ripple voltage in the -150V. leg of the negative output pulse amplifier power supply. This ripple voltage increases as the output amplifier draws more current. The bias on the control grid of V53A is set at such a level by potentiometer R602 that the ripple voltage will take control of the tube at the point where the power amplifiers are drawing rated current and change the reference to lower the variable supply voltage. Thus, the output tubes are never allowed to exceed their dissipation ratings even if the duty factor limitation is inadvertantly exceeded. At the time the variable voltage starts to decrease due to duty cycle limiting, the front panel lamp I530 lights to warn the operator that the amplitude of the output pulse is being automatically reduced.

NOTE: Since the duty factor limiting circuitry is operated by the negative output pulse channel, it is important that the negative output be terminated in an external load of 50Ω at all times in order to properly protect the output tubes.

CIRCUIT THEORY

This section of the manual contains explanations of several basic circuits which are used in the model B7D. Inasmuch as the technician may not be totally familiar with high repetition rate pulse handling circuitry, it is felt that the inclusion of this section in the manual will lend to a more thorough understanding of the instrument.

FREE-RUNNING MULTIVIBRATOR Fig. D is a simplified circuit of a free-running multivibrator similar to that used in the oscillator section of the model B7D.

Arbitrarily assume that at any specified instant, triode section V1 is conducting fully and triode section V2 is non-conducting because the potential at its control grid is below the cutoff potential of the tube. At this instant, the plate voltage of V1 is lowered due to the current flow through V1 and R1. C2 discharges to this voltage, holding V2 cut off.

After a time determined by the discharge time of C2 through R4, the voltage potential on the grid of V2 reaches the cut-in potential of the tube. V2 starts to conduct and its plate potential drops. This drop is immediately felt at the grid of V1 across C1, driving it to cut-off. Its plate potential rises sharply and capacitor C2 charges to the new voltage, further aiding in the conduction of V2. After the initial change, V2 steadies to a low plate voltage and C1 discharges to the cut-in potential of V1 and the cycle starts over again.

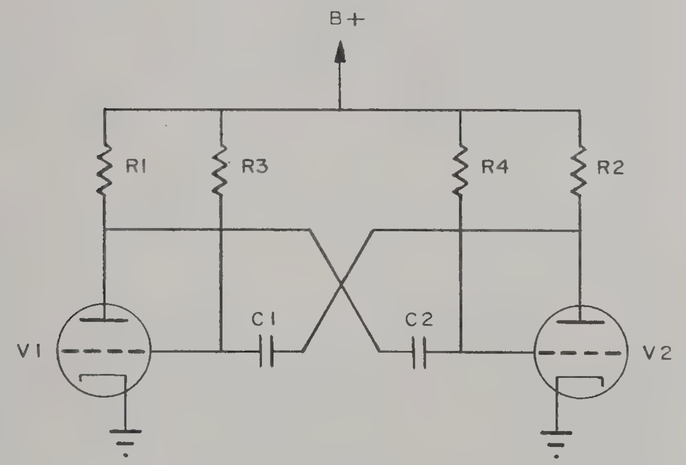


FIG. D FREE – RUNNING MULTIVIBRATOR

In summary, the operation of this circuit consists of periods of time when one tube conducts a high current while the other tube is cut off, followed by an extremely rapid change to the other tube conducting and the first tube cut off.

The repetition rate of the circuit is determined by the time constants of C1-R3 and C2-R4 and the voltage to which they are returned.

In the model B7D the range of the repetition rate of the oscillator is changed by changing the values of C1 and C2 in decade steps and the repetition rate is made continuously variable for each range by varying the level of the grid return voltage.

MONOSTABLE MULTIVIBRATOR Fig. E shows a simplified circuit of a monostable multivibrator similar to those used in the pulse delay and pulse width sections of the model B7D.

The multivibrator has one stable state and one quasi-stable state. That is, one tube section is capable of remaining in the conducting state indefinitely while the other does not have this capability. In this type of multivibrator

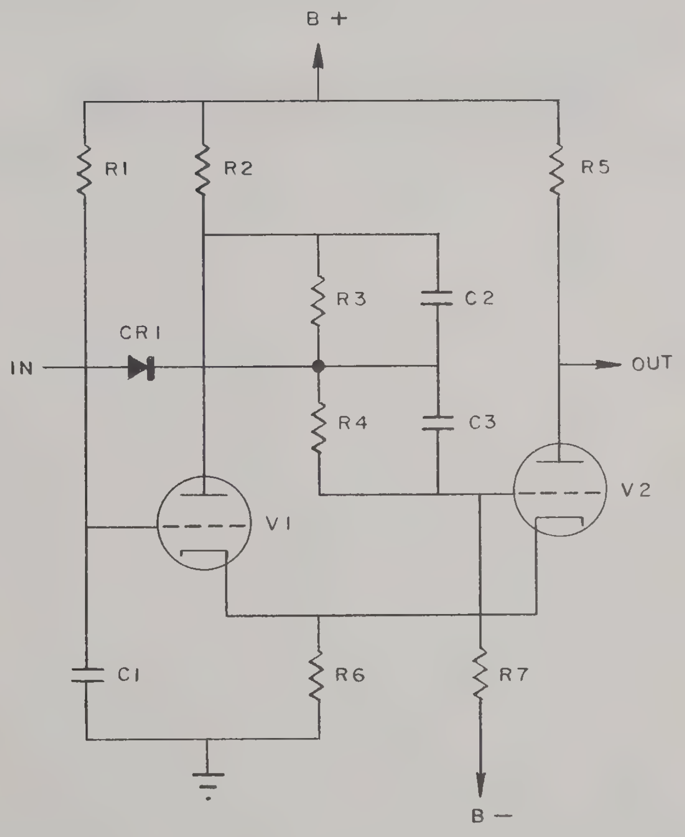


FIG. E MONOSTABLE MULTIVIBRATOR

it is necessary to trigger the circuit from its stable state to its quasi-stable state with trigger pulses from an external source. Then, the circuit will automatically return to its stable state after a certain length of time. Therefore, in operation, one triode section is triggered from non-conduction to conduction with an applied trigger. It remains in this condition for a predetermined length of time and then returns abruptly to the non-conducting state to await another trigger. Thus, we are able to generate a pulse, at a predetermined time after a given input pulse, by abruptly changing a tube section from conduction to non-conduction. Or, essentially, we have introduced a delay into the system.

Assume that the circuit is in its stable state. V1 is conducting, its grid clamped to its cathode. If R2 is made quite large, the full conduction current through V1 and thus through R6 is small and the grid is clamped near zero potential. The plate of V1, however, is at quite a low potential due to the current through the large R2. V2 is not conducting, its grid held below cut-off by the divider formed by R3, R4, and R7 between the low positive plate potential of V1 and -150 volts.

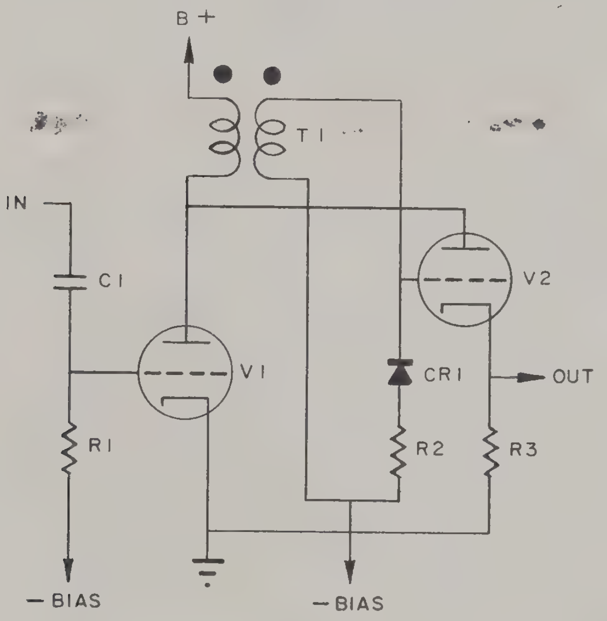


FIG. F MONOSTABLE BLOCKING OSCILLATOR

Now, at some time, a positive timing pulse arrives at the junction of the C2-R3, C3-R4 combination through diode CR1. This pulse is felt sharply across C2 and C3 at the plate of V1 and the grid of V2. V1 starts to cut off. V2 starts conducting. If R5 is small compared to R2, V2 will conduct much more heavily than V1 was conducting. The drop across R6 becomes greater due to this higher current through V2, thus the cathodes raise to a higher potential. This holds V1 off completely. The plate of V1, now at a higher potential, keeps the grid of V2 above its cut-off potential by the same divider network mentioned above. Thus, in a very short time, a trigger pulse has changed the state of the multivibrator from that of V1 conducting a small amount and V2 cut off, to one of V1 cut off and V2 conducting quite heavily.

As soon as V1 is cut off by raising its cathode potential several volts with respect to its grid potential, C1 starts to charge through R1 toward the B+ potential. After a time, predetermined by the R1-C1 combination, the grid of V1 will reach cut-in potential and V1 will again start to conduct. The plate of V1 drops. This drop is felt at the grid of V2 through C2 and C3, immediately cutting off V2. The drop which cuts V2 off also drops the cathode potentials, which aids the conduction of V1. C1 discharges rapidly through the low grid to cathode resistance of V1, and the circuit has returned to its original stable state. At the transition point of V2 conducting to non-conducting, the plate waveform of V2 goes sharply positive. This waveform is taken as the output. Thus, we have produced a pulse, delayed from the original trigger pulse, by a time predetermined by R1-C1.

In the model B7D the range of delay of the pulse delay and pulse width multivibrators is changed by changing the value of C1 in decade steps. Delay and width are made continuously variable through any range by varying R6, which varies the cathode potential in the quasi-stable state, thus determining the potential which the grid must reach to cut V1 on and return the multivibrator to its stable state.

BLOCKING OSCILLATOR Fig. F shows a typical blocking oscillator circuit such as is used in the model B7D oscillator and pulse delay sections.

This blocking oscillator is a so-called monostable or driven type. That is, it is not free-running, but requires a trigger from an external source to excite it. It produces a high powered, extremely sharp, narrow pulse which is essentially independent of the shape or degradation of the pulse which triggers it.

V1 serves to amplify the input trigger and to eliminate the possibility of a reaction by the blocking oscillator back on the trigger pulse source.

In the quiescent condition, both sections of the tube are biased below cut-off. A positive trigger is coupled through C1 to the amplifier tube, V1, which inverts and amplifies it. Pulse transformer T1 inverts and applies this waveform to the grid of V2, the blocking oscillator tube. V2 conducts causing a drop in its plate voltage. The drop in plate voltage in turn causes an increase in grid viltage, which results in a further decrease in plate voltage. Due to the AC loop gain of the circuit being greater than unity, regeneration occurs. The plate drives abruptly downward and the grid abruptly upward. This action continues until such time as the loop gain drops below unity, due to the nonlinearity of the tube.

The plate and grid cannot remain at the values attained by the regenerative action described above because of the low frequency characteristics of the transformer. The grid starts to drop due to its finite magnetizing inductance. When the grid voltage has dropped far enough that the loop gain once again equals unity, a regenerative action once again occurs in the direction to turn the tube off.

An overshoot occurs at the plate and grid of the tube. At the conclusion of the pulse there is still a current flowing in the magnetizing inductance of the transformer. Since this current cannot change instantaneously, it continues to flow through the effective capacitance of the transformer after the tube current has dropped to zero, causing this overshoot.

The pulse width and rise time are dependent almost entirely on the design of the transformer. The pulse transformers used in the model B7D blocking oscillators are specifically designed to produce extremely narrow, fast rise time pulses.

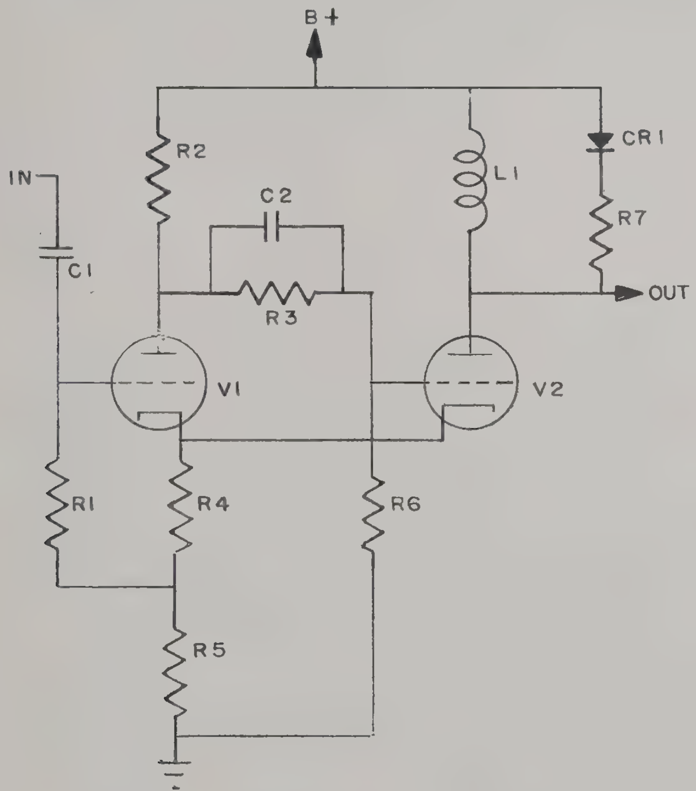


FIG. G SCHMITT TRIGGER

In the oscillator and pulse width sections of the model B7D, blocking oscillators such as described above are used. In both of these cases, a positive pulse is taken from the cathode as the output pulse.

SCHMITT TRIGGER Figure "G" shows a typical Schmitt trigger circuit such as is used in the model B7D oscillator section.

The Schmitt trigger is a monostable circuit. That is, it is not free-running but requires a trigger from an external source to excite it. This circuit produces an extremely sharp pulse which is essentially independent of the amplitude and waveform of the pulse which triggers it.

In the quiescent condition, V2 is conducting, V1 is not conducting, its grid held below cut-off by the divider network formed by R4 and R5 between the cathodes of V1 and V2 and ground. A positive trigger is coupled through C1 to the grid of V1, causing the tube to conduct. For an instant, the voltage across the cathode resistors increases, driving the grid of V2 towards cut-off. This, in addition to the drop in plate voltage of V1, causes a rapid change in V2 from conducting to a cut-off condition. V2 will remain cut off until the input signal has decreased to the cut-off value of V1. As soon as V1 is cut off by the changing input signal, the plate voltage of V1 will rise, causing the voltage on the grid of V2 to rise, and V2 conducts.

Thu[redacted]s been triggered between its two stable states by a trigger pulse whose amplitude exceeded a definite positive value and changed to a definite less positive value.

PARTS LIST

This parts list contains identifying information on all of the replaceable parts contained in the Model B7D. These parts are listed in alpha-numerical order by schematic symbol number. All items with or without circuit reference numbers are considered replaceable parts.

The column headed "RUTHERFORD ELECTRONICS CO. STOCK #" is the component identifying number assigned by the RUTHERFORD ELECTRONICS CO.

The column headed "CIRCUIT REFERENCE #" designates the component as it is found on the schematic diagram, Dwg. # 0010009, 0010010, 0010011, and 0010012.

The column headed "DESCRIPTION" is, in general, a full electrical description of the component.

The column headed "SUGGESTED UNIT PRICE" gives only an indication of the probable cost for a single unit of the component or assembly listed, if purchased from the RUTHERFORD ELECTRONICS CO. It is not, in any case, to be construed as a firm price quotation. Any customer wishing to purchase a complete or partial set of spare parts should enter a request for quotation of price and delivery to the RUTHERFORD ELECTRONICS CO. or their authorized representatives.

The column headed "SUGGESTED SPARES" lists the
facturer recommends as

PRICE INFORMATION

The parts pricing information in this manual is currently being revised. Please contact the factory or an authorized CMC representative in your area for correct parts pricing.

PPI

ABBREVIATIONS

cer	ceramic	m	milli or 10^{-3}	PT	paper tubular
comp	composition	meg	megohm or 10^{6} ohms	SET	solid electrolytic tantalum
EMC	electrolytic, metal cased	MF	metal film		
EMT	electrolytic, metal tubular	µ	micro or 10^{-6}	SM	silvered mica
f	farad	µµ	micromicro or 10^{-12}	V	working volts, DC
GMV	guaranteed minimum value	Ω	ohm	var	variable
h	henry	prec	precision	W	watt
k	kilohm or 10^{3} ohms	MM	Metalized Mylar	WW	wire wound
				DM	dipped mica

REC – CMC STOCK NUMBER CROSS-REFERENCE

Some of the Rutherford Electronics Co. (REC) stock numbers for parts listed in the parts list have been changed to CMC numbers listed below. These parts should be ordered by the CMC numbers.

REC NO.	CMC NO.
1420002	4410027
1420005	4108200
1518001	4008605
1518003	4008624
1518004	4008608
1518009	4008611
1518010	4008623
1518013	4008615
1518022	4001103
1518025	4008622
1518027	4045253
1518033	4001102
1520001	4030033
1520014	4030034
1520022	4031028
1520027	4031026
1520030	4030035
1520034	4031025
1520036	4033039
1520038	4033057
1520043	4031027
1520046	4033038
1528001	4053824
1528007	4053826
1528010	4053822
1528012	4053025
1528025	4054221
1528030	4066335
1528062	4053827
1528064	4052101
1528065	4052151
1528066	4052181
1528067	4054331
1528068	4066335
1528069	4053829
1528071	4052220
1528072	4055330 or 4066338
1528073	4054241
1534004	4066336
1534009	4058103
1534011	4058107
1534012	4058105
1534016	4066333
1534017	4058104
1542001	4011106
1574001	4040123
1574002	4040124
1574003	4040125
1574004	4040119
1574005	4040126
1574006	4040129
1580012	4102053
1816005	5101322
1816006	5101324
1816008	5101325
1816014	5101326

REC NO.	CMC NO.
1816019	5101327
1816023	5101314
1816030	5101315
2114002	4404327
2118003	4104017
2128003	4103193
2128006	4103193
2128020	4103177
2154005	4103188
2154009	4103189
2154013	4103192
2154018	4103191
2354001	5101313
2354002	5101316
2354003	5101317
2354005	5101323
2410001	4405026
2420009	4401141
2420019	4401144
2422025	4402081
2422026	4402079
2422027	4402086
2422028	4402084
2422033	4402083
2500001	4401145
2514009	4106033 and 4106034
2514011	4404190
2514012	4409059
2520003	4108171
2520004	5101328
2612002	4501062
2810004	4104007
2814002	4104021
2814003	4104009
2814004	4104007
2814007	4104035
2814011	4104083
2814019	4104120
2814902	4104021
2816001	4404326
2818001	4108099
2818004	4108100
2818006	4108104
2820002	4403078
2820004	4403102
2822004	5365004
2822005	5365006
2822008	5365008
2822010	5365010
2822012	5369021
2822015	4406049
2822018	4406057
2822019	4406047
2822020	4406048
2822021	5369027
2822023	4404211

REC NO.	CMC NO.
2822024	4406056
2824002	4404325
2824004	4404324
2826002	5374188
2826004	5374312
2828007	5304250
2828018	5306312
2828020	5306500
2828034	5341085
2828062	5341017
2830022	4404323
2830024	4404322
2830026	4404350
2830029	4404332
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2832004	4105001
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2832006	4105004
2832007	4105005
2832011	4403093
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2836003	4403092
2840003	4404321
2840005	4403090
2844003	5361105
2844004	5361107
2844006	5361111
2844007	5363105
2844008	5363107
2844010	5363111
2844011	5360107
2844012	5360109
2844015	4108523
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3120002	5400012
3120007	5401017
3130003	4108124
3130008	4108525
3130014	4108236
3512001	4501064
3912001	4902009
3912002	4902007
3912003	4902019
4260100	4617100
4700008	5000247
4700009	5002515
4700012	5002522
4700013	5002511
4700018	5002524
4700021	5002517
4700023	5002513
4700024	5002526
4700025	5002521
4700028	5002516
4700030	5002525
4700031	5002518
4700032	5002514

REC NO.	CMC NO.
4700059	5002528
4700060	5002529
4700061	5002530
4700067	5002512
4705008	5002532
4705009	5002527
4705010	5002531
4717018	4680204
4720017	4901062
4725094	4630682
4725095	4630723
4725099	4630104
4735003	4629400
4735004	4629409
4735007	4629403
4735010	4629003
4735011	4629408
4735015	4629407
4735019	4629406
4735032	4629002
4735035	4629001
4735037	4629405
4753015	4609015
4753100	4609100
4753154	4609154
4753224	4609224
4753270	4609270
4753274	4683274
4753304	4609304
4753360	4609360
4753753	4609753
4754330	4613330
4754360	4613360
4755161	4685161
4755470	4685470
4755750	4616750
4756100 thru 4756126	4601100 thru 4601126
4756331	4601331
4758033	4610033
4758100	4610100
4758101	4610101
4758102	4610102
4758103	4610103
4758104	4610104
4758105	4610105
4758121	4610121
4758122	4610122
4758123	4610123
4758124	4610124
4758151	4610151
4758152	4610152
4758153	4610153
4758154	4610154
4758181	4686181
4758220	4610220
4758221	4610221

PRICE INFORMATION

The parts pricing information in this manual is currently being revised. Please contact the factory or an authorized CMC representative in your area for correct parts pricing.

PPI

REC – CMC STOCK NUMBER CROSS-REFERENCE

Some of the Rutherford Electronics Co. (REC) stock numbers for parts listed in the parts list have been changed to CMC numbers listed below. These parts should be ordered by the CMC numbers.

REC NO.	CMC NO.
1420002	4410027
1420005	4108200
1518001	4008605
1518003	4008624
1518004	4008608
1518009	4008611
1518010	4008623
1518013	4008615
1518022	4001103
1518025	4008622
1518027	4045253
1518033	4001102
1520001	4030033
1520014	4030034
1520022	4031028
1520027	4031026
1520030	4030035
1520034	4031025
1520036	4033039
1520038	4033057
1520043	4031027
1520046	4033038
1528001	4053824
1528007	4053826
1528010	4053822
1528012	4053025
1528025	4054221
1528030	4066335
1528062	4053827
1528064	4052101
1528065	4052151
1528066	4052181
1528067	4054331
1528068	4066335
1528069	4053829
1528071	4052220
1528072	4055330 or 4066338
1528073	4054241
1534004	4066336
1534009	4058103
1534011	4058107
1534012	4058105
1534016	4066333
1534017	4058104
1542001	4011106
1574001	4040123
1574002	4040124
1574003	4040125
1574004	4040119
1574005	4040126
1574006	4040129
1580012	4102053
1816005	5101322
1816006	5101324
1816008	5101325
1816014	5101326

REC NO.	CMC NO.
1816019	5101327
1816023	5101314
1816030	5101315
2114002	4404327
2118003	4104017
2128003	4103193
2128006	4103193
2128020	4103177
2154005	4103188
2154009	4103189
2154013	4103192
2154018	4103191
2354001	5101313
2354002	5101316
2354003	5101317
2354005	5101323
2410001	4405026
2420009	4401141
2420019	4401144
2422025	4402081
2422026	4402079
2422027	4402086
2422028	4402084
2422033	4402083
2500001	4401145
2514009	4106033 and 4106034
2514011	4404190
2514012	4409059
2520003	4108171
2520004	5101328
2612002	4501062
2810004	4104007
2814002	4104021
2814003	4104009
2814004	4104007
2814007	4104035
2814011	4104083
2814019	4104120
2814902	4104021
2816001	4404326
2818001	4108099
2818004	4108100
2818006	4108104
2820002	4403078
2820004	4403102
2822004	5365004
2822005	5365006
2822008	5365008
2822010	5365010
2822012	5369021
2822015	4406049
2822018	4406057
2822019	4406047
2822020	4406048
2822021	5369027
2822023	4404211

REC NO.	CMC NO.
2822024	4406056
2824002	4404325
2824004	4404324
2826002	5374188
2826004	5374312
2828007	5304250
2828018	5306312
2828020	5306500
2828034	5341085
2828062	5341017
2830022	4404323
2830024	4404322
2830026	4404350
2830029	4404332
2832001	4403091
2832004	4105001
2832005	4105002
2832006	4105004
2832007	4105005
2832011	4403093
2836001	4403087
2836003	4403092
2840003	4404321
2840005	4403090
2844003	5361105
2844004	5361107
2844006	5361111
2844007	5363105
2844008	5363107
2844010	5363111
2844011	5360107
2844012	5360109
2844015	4108523
2844022	4108234
2844030	4108235
3120002	5400012
3120007	5401017
3130003	4108124
3130008	4108525
3130014	4108236
3512001	4501064
3912001	4902009
3912002	4902007
3912003	4902019
4260100	4617100
4700008	5000247
4700009	5002515
4700012	5002522
4700013	5002511
4700018	5002524
4700021	5002517
4700023	5002513
4700024	5002526
4700025	5002521
4700028	5002516
4700030	5002525
4700031	5002518
4700032	5002514

REC NO.	CMC NO.
4700059	5002528
4700060	5002529
4700061	5002530
4700067	5002512
4705008	5002532
4705009	5002527
4705010	5002531
4717018	4680204
4720017	4901062
4725094	4630682
4725095	4630723
4725099	4630104
4735003	4629400
4735004	4629409
4735007	4629403
4735010	4629003
4735011	4629408
4735015	4629407
4735019	4629406
4735032	4629002
4735035	4629001
4735037	4629405
4753015	4609015
4753100	4609100
4753154	4609154
4753224	4609224
4753270	4609270
4753274	4683274
4753304	4609304
4753360	4609360
4753753	4609753
4754330	4613330
4754360	4613360
4755161	4685161
4755470	4685470
4755750	4616750
4756100 thru 4756126	4601100 thru 4601126
4756331	4601331
4758033	4610033
4758100	4610100
4758101	4610101
4758102	4610102
4758103	4610103
4758104	4610104
4758105	4610105
4758121	4610121
4758122	4610122
4758123	4610123
4758124	4610124
4758151	4610151
4758152	4610152
4758153	4610153
4758154	4610154
4758181	4686181
4758220	4610220
4758221	4610221

REC – CMC STOCK NUMBER CROSS-REFERENCE

Some of the Rutherford Electronics Co. (REC) stock numbers for parts listed in the parts list have been changed to CMC numbers listed below. These parts should be ordered by the CMC numbers.

REC NO.	CMC NO.
1420002	4410027
1420005	4108200
1518001	4008605
1518003	4008624
1518004	4008608
1518009	4008611
1518010	4008623
1518013	4008615
1518022	4001103
1518025	4008622
1518027	4045253
1518033	4001102
1520001	4030033
1520014	4030034
1520022	4031028
1520027	4031026
1520030	4030035
1520034	4031025
1520036	4033039
1520038	4033057
1520043	4031027
1520046	4033038
1528001	4053824
1528007	4053826
1528010	4053822
1528012	4053025
1528025	4054221
1528030	4066335
1528062	4053827
1528064	4052101
1528065	4052151
1528066	4052181
1528067	4054331
1528068	4066335
1528069	4053829
1528071	4052220
1528072	4055330 or 4066338
1528073	4054241
1534004	4066336
1534009	4058103
1534011	4058107
1534012	4058105
1534016	4066333
1534017	4058104
1542001	4011106
1574001	4040123
1574002	4040124
1574003	4040125
1574004	4040119
1574005	4040126
1574006	4040129
1580012	4102053
1816005	5101322
1816006	5101324
1816008	5101325
1816014	5101326

REC NO.	CMC NO.
1816019	5101327
1816023	5101314
1816030	5101315
2114002	4404327
2118003	4104017
2128003	4103193
2128006	4103193
2128020	4103177
2154005	4103188
2154009	4103189
2154013	4103192
2154018	4103191
2354001	5101313
2354002	5101316
2354003	5101317
2354005	5101323
2410001	4405026
2420009	4401141
2420019	4401144
2422025	4402081
2422026	4402079
2422027	4402086
2422028	4402084
2422033	4402083
2500001	4401145
2514009	4106033 and 4106034
2514011	4404190
2514012	4409059
2520003	4108171
2520004	5101328
2612002	4501062
2810004	4104007
2814002	4104021
2814003	4104009
2814004	4104007
2814007	4104035
2814011	4104083
2814019	4104120
2814902	4104021
2816001	4404326
2818001	4108099
2818004	4108100
2818006	4108104
2820002	4403078
2820004	4403102
2822004	5365004
2822005	5365006
2822008	5365008
2822010	5365010
2822012	5369021
2822015	4406049
2822018	4406057
2822019	4406047
2822020	4406048
2822021	5369027
2822023	4404211

REC NO.	CMC NO.
2822024	4406056
2824002	4404325
2824004	4404324
2826002	5374188
2826004	5374312
2828007	5304250
2828018	5306312
2828020	5306500
2828034	5341085
2828062	5341017
2830022	4404323
2830024	4404322
2830026	4404350
2830029	4404332
2832001	4403091
2832004	4105001
2832005	4105002
2832006	4105004
2832007	4105005
2832011	4403093
2836001	4403087
2836003	4403092
2840003	4404321
2840005	4403090
2844003	5361105
2844004	5361107
2844006	5361111
2844007	5363105
2844008	5363107
2844010	5363111
2844011	5360107
2844012	5360109
2844015	4108523
2844022	4108234
2844030	4108235
3120002	5400012
3120007	5401017
3130003	4108124
3130008	4108525
3130014	4108236
3512001	4501064
3912001	4902009
3912002	4902007
3912003	4902019
4260100	4617100
4700008	5000247
4700009	5002515
4700012	5002522
4700013	5002511
4700018	5002524
4700021	5002517
4700023	5002513
4700024	5002526
4700025	5002521
4700028	5002516
4700030	5002525
4700031	5002518
4700032	5002514

REC NO.	CMC NO.
4700059	5002528
4700060	5002529
4700061	5002530
4700067	5002512
4705008	5002532
4705009	5002527
4705010	5002531
4717018	4680204
4720017	4901062
4725094	4630682
4725095	4630723
4725099	4630104
4735003	4629400
4735004	4629409
4735007	4629403
4735010	4629003
4735011	4629408
4735015	4629407
4735019	4629406
4735032	4629002
4735035	4629001
4735037	4629405
4753015	4609015
4753100	4609100
4753154	4609154
4753224	4609224
4753270	4609270
4753274	4683274
4753304	4609304
4753360	4609360
4753753	4609753
4754330	4613330
4754360	4613360
4755161	4685161
4755470	4685470
4755750	4616750
4756100	4601100
thru	thru
4756126	4601126
4756331	4601331
4758033	4610033
4758100	4610100
4758101	4610101
4758102	4610102
4758103	4610103
4758104	4610104
4758105	4610105
4758121	4610121
4758122	4610122
4758123	4610123
4758124	4610124
4758151	4610151
4758152	4610152
4758153	4610153
4758154	4610154
4758181	4686181
4758220	4610220
4758221	4610221

PARTS LIST

This parts list contains identifying information on all of the replaceable parts contained in the Model B7D. These parts are listed in alpha-numerical order by schematic symbol number. All items with or without circuit reference numbers are considered replaceable parts.

The column headed "RUTHERFORD ELECTRONICS CO. STOCK #" is the component identifying number assigned by the RUTHERFORD ELECTRONICS CO.

The column headed "CIRCUIT REFERENCE #" designates the component as it is found on the schematic diagram, Dwg. # 0010009, 0010010, 0010011, and 0010012.

The column headed "DESCRIPTION" is, in general, a full electrical description of the component.

The column headed "SUGGESTED UNIT PRICE" gives only an indication of the probable cost for a single unit of the component or assembly listed, if purchased from the RUTHERFORD ELECTRONICS CO. It is not, in any case, to be construed as a firm price quotation. Any customer wishing to purchase a complete or partial set of spare parts should enter a request for quotation of price and delivery to the RUTHERFORD ELECTRONICS CO. or their authorized representatives.

The column headed "SUGGESTED SPARES" lists the quantity of each of the items which the manufacturer recommends as spares for one (1) years operation.

When ordering a complete or partial set of spares, specify by listing all of the information contained in this list for that particular part. The more descriptive information given on a parts order, the less chance there is for expensive and time consuming error.

[redacted] Prices are subject to change without notice.

ABBREVIATIONS

cer	ceramic
comp	composition
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
f	farad
GMV	guaranteed minimum value
h	henry
k	kilohm or 10^{3} ohms
m	milli or 10^{-3}
meg	megohm or 10^{6} ohms
MF	metal film
μ	micro or 10^{-6}
μμ	micromicro or 10^{-12}
Ω	ohm
prec	precision
MM	Metalized Mylar
PT	paper tubular
SET	solid electrolytic tantalum
SM	silvered mica
V	working volts, DC
var	variable
W	watt
WW	wire wound
DM	dipped mica

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1420002	4410027
1420005	4108200
1518001	4008605
1518003	4008624
1518004	4008608
1518009	4008611
1518010	4008623
1518013	4008615
1518022	4001103
1518025	4008622
1518027	4045253
1518033	4001102
1520001	4030033
1520014	4030034
1520022	4031028
1520027	4031026
1520030	4030035
1520034	4031025
1520036	4033039
1520038	4033057
1520043	4031027
1520046	4033038
1528001	4053824
1528007	4053826
1528010	4053822
1528012	4053025
1528025	4054221
1528030	4066335
1528062	4053827
1528064	4052101
1528065	4052151
1528066	4052181
1528067	4054331
1528068	4066335
1528069	4053829
1528071	4052220
1528072	4055330
	or
	4066338
1528073	4054241
1534004	4066336
1534009	4058103
1534011	4058107
1534012	4058105
1534016	4066333
1534017	4058104
1542001	4011106
1574001	4040123
1574002	4040124
1574003	4040125
1574004	4040119
1574005	4040126
1574006	4040129
1580012	4102053
1816005	5101322
1816006	5101324
1816008	5101325
1816014	5101326
1816019	5101327
1816023	5101314
1816030	5101315
2114002	4404327
2118003	4104017
2128003	4103193
2128006	4103193
2128020	4103177
2154005	4103188
2154009	4103189
2154013	4103192
2154018	4103191
2354001	5101313
2354002	5101316
2354003	5101317
2354005	5101323
2410001	4405026
2420009	4401141
2420019	4401144
2422025	4402081
2422026	4402079
2422027	4402086
2422028	4402084
2422033	4402083
2500001	4401145
2514009	4106033
	and
	4106034
2514011	4404190
2514012	4409059
2520003	4108171
2520004	5101328
2612002	4501062
2810004	4104007
2814002	4104021
2814003	4104009
2814004	4104007
2814007	4104035
2814011	4104083
2814019	4104120
2814902	4104021
2816001	4404326
2818001	4108099
2818004	4108100
2818006	4108104
2820002	4403078
2820004	4403102
2822004	5365004
2822005	5365006
2822008	5365008
2822010	5365010
2822012	5369021
2822015	4406049
2822018	4406057
2822019	4406047
2822020	4406048
2822021	5369027
2822023	4404211
2822024	4406056
2824002	4404325
2824004	4404324
2826002	5374188
2826004	5374312
2828007	5304250
2828018	5306312
2828020	5306500
2828034	5341085
2828062	5341017
2830022	4404323
2830024	4404322
2830026	4404350
2830029	4404332
2832001	4403091
2832004	4105001
2832005	4105002
2832006	4105004
2832007	4105005
2832011	4403093
2836001	4403087
2836003	4403092
2840003	4404321
2840005	4403090
2844003	5361105
2844004	5361107
2844006	5361111
2844007	5363105
2844008	5363107
2844010	5363111
2844011	5360107
2844012	5360109
2844015	4108523
2844022	4108234
2844030	4108235
3120002	5400012
3120007	5401017
3130003	4108124
3130008	4108525
3130014	4108236
3512001	4501064
3912001	4902009
3912002	4902007
3912003	4902019
4260100	4617100
4700008	5000247
4700009	5002515
4700012	5002522
4700013	5002511
4700018	5002524
4700021	5002517
4700023	5002513
4700024	5002526
4700025	5002521
4700028	5002516
4700030	5002525
4700031	5002518
4700032	5002514
4700059	5002528
4700060	5002529
4700061	5002530
4700067	5002512
4705008	5002532
4705009	5002527
4705010	5002531
4717018	4680204
4720017	4901062
4725094	4630682
4725095	4630723
4725099	4630104
4735003	4629400
4735004	4629409
4735007	4629403
4735010	4629003
4735011	4629408
4735015	4629407
4735019	4629406
4735032	4629002
4735035	4629001
4735037	4629405
4753015	4609015
4753100	4609100
4753154	4609154
4753224	4609224
4753270	4609270
4753274	4683274
4753304	4609304
4753360	4609360
4753753	4609753
4754330	4613330
4754360	4613360
4755161	4685161
4755470	4685470
4755750	4616750
4756100	4601100
thru	thru
4756126	4601126
4756331	4601331
4758033	4610033
4758100	4610100
4758101	4610101
4758102	4610102
4758103	4610103
4758104	4610104
4758105	4610105
4758121	4610121
4758122	4610122
4758123	4610123
4758124	4610124
4758151	4610151
4758152	4610152
4758153	4610153
4758154	4610154
4758181	4686181
4758220	4610220
4758221	4610221

REC NO.	CMC NO.
4758222	4610222
4758224	4610224
4758271	4610271
4758273	4610273
4758330	4610330
4758331	4610331
4758332	4610332
4758335	4610335
4758393	4610393
4758470	4610470
4758471	4610471
4758472	4610472
4758474	4610474
4758560	4610560
4758561	4610561
4758680	4610680
4758681	4610681
4758682	4610682
4758683	4610683
4758684	4610684
4758821	4610821
4758823	4610823
4759027	4614027
4759102	4614102
4759154	4614154
4759270	4614270
4759390	4614390
4759561	4614561
4760101	4617101
4760102	4617102

REC NO.	CMC NO.
4760121	4617121
4760151	4617151
4760221	4617221
4760223	4617223
4760271	4617271
4760332	4617332
4760390	4617390
4760470	4617470
4760471	4617471
4760472	4617472
4760682	4617682
4760683	4617683
4760822	4617822
4774002	4651174
4774030	4664152
4774033	4654302
4800001	4300250
4800007	4300248
4800016	4300260
4800020	4300247
4800021	4300184
4800023	4300249
4802015	4300257
4802016	4300246
4804008	4300256
4804013	4300259
4804021	4300223
4812006	4300258
4830007	4906173
4834010	4906049

REC NO.	CMC NO.
4837003	4906123
4838006	4906041
4838012	4906175
4838015	4906094
4839001	4906172
4839005	4906174
4839007	4906171
4839012	4906171
4850002	4404349
5110001	4701221
5110008	4701222
5110011	4701219
5110012	4701235
5110017	4701220
5110021	4701236
5110022	4701237
5110045	4701233
5110046	4701232
5110047	4701234
5110048	4701231
5120001	4702230
5120003	4702231
5120005	4702234
5120006	4702235
5120007	4702220
5140001	4704281
5180012	4102053
5180018	4102004
5610002	5100272
5640005	5100270

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5640018	5100271
5640021	5100266
5650001	5100267
5650002	5100268
5650004	5100269
5650010	5100273
5650011	5101329
5650012	5100274
5720001	4901014
5720008	4901065
5720010	4901048 or 4901064
5720011	4901066
5720013	4901013
5720014	4901024
5720017	4901062
5720029	4901063
6012002	6200018
6014034	6004905
6014071	6001111
6025001	6600011
6025002	6600021
6030003	4104119
6030004	4104041
8700015	4106033
8700016	4106037
8700017	4106036
8700018	4106035
8700019	4106034

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
C100	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	16
C101	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C102	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C103	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C104	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C105	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C110	1534011	CAPACITOR, fixed, mylar, 0.47μf, 200V, ± 1%	2.25	2
C111	1534011	CAPACITOR, fixed, mylar, 0.47μf, 200V, ± 1%	2.25	
C112	1534004	CAPACITOR, fixed, mylar, 0.047μf, 200V, ± 1%	2.28	2
C113	1534004	CAPACITOR, fixed, mylar, 0.047μf, 200V, ± 1%	2.28	
C114	1528069	CAPACITOR, fixed, DM, 4700μμf, 500V, ± 1%	1.12	2
C115	1528069	CAPACITOR, fixed, DM, 4700μμf, 500V, ± 1%	1.12	
C116	1528068	CAPACITOR, fixed, DM, 470μμf, 500V, ± 1%	.40	2
C117	1528068	CAPACITOR, fixed, DM, 470μμf, 500V, ± 1%	.40	
C118	1574003	CAPACITOR, var, mica, 5-80μμf, 175V,	.55	2
C119	1528062	CAPACITOR, fixed, DM, 47μμf, 500V, ± 5%	.40	1
C120	1518009	CAPACITOR, fixed, cer, 100μμf, 500V, ±10%	.15	
C121	1528001	CAPACITOR, fixed, SM, 5μμf, 500V, ± 5%	.40	1
C122	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C123	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C130	1518009	CAPACITOR, fixed, cer, 100μμf, 500V, ±10%	.15	
C131	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C132	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C200	1534011	CAPACITOR, fixed, mylar, 0.47μf, 200V, ± 1%	2.25	
C201	1534004	CAPACITOR, fixed, mylar, 0.047μf, 200V, ± 1%	2.28	
C202	1528069	CAPACITOR, fixed, DM, 4700μμf, 500V, ± 1%	1.12	
C203	1528068	CAPACITOR, fixed, DM, 470μμf, 500V, ± 1%	.40	
C204	1574003	CAPACITOR, var, mica, 5-80μμf, 175V,	.55	
C205	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C206	1528064	CAPACITOR, fixed, DM, 100μμf, 500V, ± 5%	.17	3
C207	1528064	CAPACITOR, fixed, DM, 100μμf, 500V, ± 5%	.17	
C208	1518009	CAPACITOR, fixed, cer, 100μμf, 500V, ±10%	.15	
C209	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C210	1518009	CAPACITOR, fixed, cer, 100μμf, 500V, ±10%	.15	
C211	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	
C212	1518022	CAPACITOR, fixed, cer, 0.01μf, 500V, GMV	.15	

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG-SPARES
C213	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C250	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C260	1574001	CAPACITOR, var, mica, 1.5-15µµf, 17V,	.55	1
C261	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C300	1534011	CAPACITOR, fixed, mylar, 0.47µf, 200V, ± 1%	2.25	
C301	1534004	CAPACITOR, fixed, mylar, 0.047µf, 200V, ± 1%	2.28	
C302	1528069	CAPACITOR, fixed, DM, 4700µµf, 500V, ± 1%	1.12	
C303	1528068	CAPACITOR, fixed, DM, 470µµf, 500V, ± 1%	.40	
C304	1574003	CAPACITOR, var, mica, 5-80µµf, 175V,	.55	
C306	1528064	CAPACITOR, fixed, DM, 100µµf, 500V, ± 5%	.17	
C307	1528064	CAPACITOR, fixed, DM, 100µµf, 500V, ± 5%	.17	
C308	1518009	CAPACITOR, fixed, cer, 100µµf, 500V, ±10%	.15	
C309	1520001	CAPACITOR, fixed, EMT, 2µf, 450V, -10+50%	1.00	2
C310	1534009	CAPACITOR, fixed, MM, 0.25µf, 400V, ±20%	1.20	2
C311	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C350	1574002	CAPACITOR, var, mica, 2.7-30µµf, 175V,	.50	1
C351	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C352	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C360	1574002	CAPACITOR, var, mica, 2.7-30µµf, 175V,	.50	
C361	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C362	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C363	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C400	1534012	CAPACITOR, fixed, MM, 0.5µf, 600V, ±20%	1.59	1
C401	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C404	1518025	CAPACITOR, fixed, cer, 0.03µf, 500V, ±20%	.20	1
C405	1520001	CAPACITOR, fixed, EMT, 2µf, 450V, -10+50%	1.00	
C406	1534012	CAPACITOR, fixed, MM, 0.5µf, 600V, ±20%	1.59	
C407	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
C450	1520014	CAPACITOR, fixed, EMT, 20µf, 250V, -10+50%	1.35	2
C451	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C452	1528010	CAPACITOR, fixed, SM, 33µµf, 500V, ± 5%	.40	1
C453	1528007	CAPACITOR, fixed, SM, 22µµf, 500V, ± 5%	.40	1
C454	1520014	CAPACITOR, fixed, EMT, 20µf, 250V, -10+50%	1.35	
C455	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C460	1520014	CAPACITOR, fixed, EMT, 20µf, 250V, -10+50%	1.35	
C461	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C462	1528010	CAPACITOR, fixed, SM, 33µµf, 500V, ± 5%	.40	
C463	1520014	CAPACITOR, fixed, EMT, 20µf, 250V, -10+50%	1.35	
C464	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C470	1534009	CAPACITOR, fixed, MM, 0.25µf, 400V, ±20%	1.20	
C471	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C472	1574005	CAPACITOR, var, mica, 9-180µµf, 175V,	.50	1
C473	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
C474	1534009	CAPACITOR, fixed, MM, 0.25µf, 400V, ±20%	1.20	
C475	1534009	CAPACITOR, fixed, MM, 0.25µf, 400V, ±20%	1.20	
C476	1520001	CAPACITOR, fixed, EMT, 2µf, 450V, -10+50%	1.00	
C477	1534017	CAPACITOR, fixed, MM, 2µf, 400V, ±20%	1.46	1
C500	1520027	CAPACITOR, fixed, EMC, 80-80µf, 350V, -10+50%	4.50	2
C501	1520027	CAPACITOR, fixed, EMC, 80-80µf, 350V, -10+50%	4.50	
C502	1520027	CAPACITOR, fixed, EMC, 80-80µf, 350V, -10+50%	4.50	
C503	1542001	CAPACITOR, fixed, PT, 0.1µf, 400V, ±20%	.35	3
C520	1542001	CAPACITOR, fixed, PT, 0.1µf, 400V, ±20%	.35	
C521	1520001	CAPACITOR, fixed, EMT, 2µf, 450V, -10+50%	1.00	
C522	1542001	CAPACITOR, fixed, PT, 0.1µf, 400V, ±20%	.35	
C523	1520001	CAPACITOR, fixed, EMT, 2µf, 450V, -10+50%	1.00	
C530	1542001	CAPACITOR, fixed, PT, 0.1µf, 400V, ±20%	.35	
C531	1542001	CAPACITOR, fixed, PT, 0.1µf, 400V, ±20%	.35	
C540	1520035	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	2
C541	1520035	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	
C542	1520035	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG-SPARES
C600	1520022	CAPACITOR, fixed, EMT, 50µf, 25V, -10+100%	2.10	1
C601	1520034	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	2
C602	1520034	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	
C603	1520034	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	
C604	1520034	CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50%	6.00	
C700	1520043	CAPACITOR, fixed, EMC, 1500µf, 50V, -10+50%	4.00	1
C801	1534017	CAPACITOR, fixed, MM, 2µf, 400V, ±20%	1.46	
C806	1520014	CAPACITOR, fixed, EMT, 20µf, 250V, -10+50%	1.35	
C807	1518027	CAPACITOR, fixed, cer, 0.1µf, 100V, +80-20%	.35	1
C808	1520014	CAPACITOR, fixed, EMT, 20µf, 250V, -10+50%	1.35	
C809	1518027	CAPACITOR, fixed, cer, 0.1µf, 100V, +80-20%	.35	
C810	1518022	CAPACITOR, fixed, cer, 0.01µf, 500V, GMV	.15	
CR120	4800009	DIODE, germanium, 1N116	1.50	4
CR130	4800001	DIODE, germanium, 1N34A	.45	3
CR200	4800001	DIODE, germanium, 1N34A	.45	
CR201	4800009	DIODE, germanium, 1N116	1.50	
CR210	4800001	DIODE, germanium, 1N34A	.45	
CR250	4800020	DIODE, germanium, 1N774	.82	3
CR251	4800020	DIODE, germanium, 1N774	.82	
CR300	4800001	DIODE, germanium, 1N34A	.45	
CR301	4800009	DIODE, germanium, 1N116	1.50	
CR350	4800020	DIODE, germanium, 1N774	.82	
CR360	4800020	DIODE, germanium, 1N774	.82	
CR361	4800020	DIODE, germanium, 1N774	.82	
CR370	4800007	DIODE, germanium, 1N98	.69	6
CR371	4800007	DIODE, germanium, 1N98	.69	
CR372	4800007	DIODE, germanium, 1N98	.69	

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG-SPARES
CR373	4800007	DIODE, germanium, 1N98	.69	
CR374	4800007	DIODE, germanium, 1N98	.69	
CR375	4800007	DIODE, germanium, 1N98	.69	
CR376	4800007	DIODE, germanium, 1N98	.69	
CR377	4800007	DIODE, germanium, 1N98	.69	
CR378	4800007	DIODE, germanium, 1N98	.69	
CR379	4800007	DIODE, germanium, 1N98	.69	
CR380	4800007	DIODE, germanium, 1N98	.69	
CR381	4800007	DIODE, germanium, 1N98	.69	
CR500	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	14
CR501	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR502	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR503	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR504	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR505	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR530	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR550	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR551	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR552	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR553	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR600	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR601	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR602	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR603	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR604	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR700	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
CR701	4802016	DIODE, silicon, SC4, 1A, 400 PIV	1.10	
DL100	2354003	DELAY LINE, fixed, 0.2 μsec.	8.50	1
DL210	2354001	DELAY LINE, fixed, 0.02 μsec.	8.50	1
F500	5180019	FUSE, Slo-Blo, 5 AMP	.18	5
FB100	2520003	FERRITE BEAD	.40	2
FB101	2520003	FERRITE BEAD	.40	

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
FB401	2520003	FERRITE BEAD	.40	
FB450	2520003	FERRITE BEAD	.40	
FB451	2520003	FERRITE BEAD	.40	
FB460	2520003	FERRITE BEAD	.40	
FB461	2520003	FERRITE BEAD	.40	
I500	3912001	LAMP, indicator	.15	1
I530	3912002	LAMP, indicator	.21	1
J100	2824002	CONNECTOR, nylon binding post	.68	1
J101	2824002	CONNECTOR, nylon binding post	.68	
J102	2128003	CONNECTOR, coax	1.00	1
J103	2128003	CONNECTOR, coax	1.00	
L120	1816030	COIL, fixed, 75µh, ±10%	.60	1
L200	1816023	COIL, fixed, 25µh, ±10%	.60	1
L300	1816023	COIL, fixed, 25µh, ±10%	.60	
P500	6025001	CORD power, w/plug, 3 wire	1.95	1
R100	4758154	RESISTOR, fixed, comp, 150K, ½W, ±10%	.12	2
R101	4758102	RESISTOR, fixed, comp, 1K, ½W, ±10%	.12	3
R102	4758103	RESISTOR, fixed, comp, 10K, ½W, ±10%	.12	1
R103	4758102	RESISTOR, fixed, comp, 1K, ½W, ±10%	.12	
R104	4758102	RESISTOR, fixed, comp, 1K, ½W, ±10%	.12	
R105	4758681	RESISTOR, fixed, comp, 680Ω, ½W, ±10%	.12	1
R110	4759102	RESISTOR, fixed, comp, 1K, 1W, ±10%	.18	2
R111	4700023	RESISTOR, var, comp, 10K, 2W, ±20%	3.00	1
R112	4759102	RESISTOR, fixed, comp, 1K, 1W, ±10%	.18	
R113	4753753	RESISTOR, fixed, comp, 75K, ½W, ± 5%	.24	1
R114	4753753	RESISTOR, fixed, comp, 75K, ½W, ± 5%	.24	
R115	4700021	RESISTOR, var, comp, 10K, 2W, ±20%	3.75	1

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG-SPARES
R116	4700009	RESISTOR, var, comp, 5K, 1W, ±20%	3.00	1
R117	4760472	RESISTOR, fixed, comp, 4.7K, 2W, ±10%	.24	1
R118	4759472	RESISTOR, fixed, comp, 4.7K, 1W, ±10%	.18	1
R120	4758332	RESISTOR, fixed, comp, 3.3K, ½W, ±10%	.12	1
R121	4758471	RESISTOR, fixed, comp, 470Ω, ½W, ±10%	.12	3
R122	4758154	RESISTOR, fixed, comp, 150K, ½W, ±10%	.12	
R123	4758105	RESISTOR, fixed, comp, 1meg, ½W, ±10%	.12	1
R124	4758102	RESISTOR, fixed, comp, 1K, ½W, ±10%	.12	
R125	4758682	RESISTOR, fixed, comp, 6.8K, ½W, ±10%	.12	1
R126	4758683	RESISTOR, fixed, comp, 68K, ½W, ±10%	.12	1
R127	4758393	RESISTOR, fixed, comp, 39K, ½W, ±10%	.12	1
R128	4758335	RESISTOR, fixed, comp, 3.3meg, ½W, ±10%	.12	1
R130	4758471	RESISTOR, fixed, comp, 470Ω, ½W, ±10%	.12	
R131	4759102	RESISTOR, fixed, comp, 1K, 1W, ±10%	.18	
R132	4758102	RESISTOR, fixed, comp, 1K, ½W, ±10%	.12	
R200	4700013	RESISTOR, var, comp, 100K, 1W, ±20%	3.00	1
R201	4758104	RESISTOR, fixed, comp, 100K, ½W, ±10%	.12	3
R202	4758470	RESISTOR, fixed, comp, 47Ω, ½W, ±10%	.12	2
R203	4758471	RESISTOR, fixed, comp, 470Ω, ½W, ±10%	.12	
R204	4630104 ~~4725099~~	RESISTOR, fixed, prec, 100K, ½W, ± 1%	.60	1
R205	4758273	RESISTOR, fixed, comp, 27K, ½W, ±10%	.12	2
R206	4758123	RESISTOR, fixed, comp, 12K, ½W, ±10%	.12	1
R207	4760221	RESISTOR, fixed, comp, 220Ω, 2W, ±10%	.24	1
R208	4700015	RESISTOR, var, comp, 500Ω, 2W, ±20%	3.75	1
R209	4753304	RESISTOR, fixed, comp, 300K, ½W, ± 5%	.24	1
R210	4758471	RESISTOR, fixed, comp, 470Ω, ½W, ±10%	.12	
R211	4758332	RESISTOR, fixed, comp, 3.3K, ½W, ±10%	.12	
R212	4760471	RESISTOR, fixed, comp, 470Ω, 2W, ±10%	.24	1
R250	4758102	RESISTOR, fixed, comp, 1K, ½W, ±10%	.12	
R251	4758151	RESISTOR, fixed, comp, 150Ω, ½W, ±10%	.12	1
R252	4758331	RESISTOR, fixed, comp, 330Ω, ½W, ±10%	.12	2
R260	4760102	RESISTOR, fixed, comp, 1K, 2W, ±10%	.24	1
R261	4760102	RESISTOR, fixed, comp, 1K, 2W, ±10%	.24	
R300	4700013	RESISTOR, var, comp, 100K, 1W, ±20%	3.00	
R301	4758104	RESISTOR, fixed, comp, 100K, ½W, ±10%	.12	

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CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG-SPARES
R302	4758470	RESISTOR, fixed, comp, 47Ω, ½W, ±10%	.12	
R303	4758471	RESISTOR, fixed, comp, 470Ω, ½W, ±10%	.12	
R304	4630104 ~~4725099~~	RESISTOR, fixed, prec, 100K, ½W, ± 1%	.60	
R305	4758273	RESISTOR, fixed, comp, 27K, ½W, ±10%	.12	
R306	4758123	RESISTOR, fixed, comp, 12K, ½W, ±10%	.12	
R307	4760471	RESISTOR, fixed, comp, 470Ω, 2W, ±10%	.24	
R308	4700015	RESISTOR, var, comp, 500Ω, 2W, ±20%	3.75	
R309	4753304	RESISTOR, fixed, comp, 300K, ½W, ± 5%	.24	
R350	4758474	RESISTOR, fixed, comp, 470K, ½W, ±10%	.12	3
R351	4758332	RESISTOR, fixed, comp, 3.3K, ½W, ±10%	.12	
R352	4758331	RESISTOR, fixed, comp, 330Ω, ½W, ±10%	.12	2
R353	4700032	RESISTOR, var, comp, 250K, 2W, ±30%	3.00	1
R354	4700028	RESISTOR, var, comp, 50K, 2W, ±30%	3.00	1
R355	4758154	RESISTOR, fixed, comp, 150K, ½W, ±10%	.12	
R356	4760683	RESISTOR, fixed, comp, 68K, 2W, ±10%	.24	1
R357	4758273	RESISTOR, fixed, comp, 27K, ½W, ±10%	.12	
R360	4758331	RESISTOR, fixed, comp, 330Ω, ½W, ±10%	.12	
R361	4758331	RESISTOR, fixed, comp, 330Ω, ½W, ±10%	.12	
R400	4760223	RESISTOR, fixed, comp, 22K, 2W, ±10%	.24	1
R410	4700025	RESISTOR, var, comp, 25K, 2W, ±10%	4.04	1
R411	4700021	RESISTOR, var, comp, 10K, 2W, ±30%	3.75	1
R412	4700025	RESISTOR, var, comp, 25K, 2W, ±10%	4.04	
R413	4700021	RESISTOR, var, comp, 10K, 2W, ±30%	3.75	
R414	4758560	RESISTOR, fixed, comp, 56Ω, ½W, ±10%	.12	1
R415	4758330	RESISTOR, fixed, comp, 33Ω, ½W, ±10%	.12	1
R450	4760100	RESISTOR, fixed, comp, 10Ω, 2W, ±10%	.24	1
R451	4760100	RESISTOR, fixed, comp, 10Ω, 2W, ±10%	.24	
R452	4758470	RESISTOR, fixed, comp, 47Ω, ½W, ±10%	.12	
R453	4758101	RESISTOR, fixed, comp, 100Ω, ½W, ±10%	.12	1
R454	4758470	RESISTOR, fixed, comp, 47Ω, ½W, ±10%	.12	
R460	4760100	RESISTOR, fixed, comp, 10Ω, 2W, ±10%	.24	
R461	4760100	RESISTOR, fixed, comp, 10Ω, 2W, ±10%	.24	
R462	4758470	RESISTOR, fixed, comp, 47Ω, ½W, ±10%	.12	
R463	4758470	RESISTOR, fixed, comp, 47Ω, ½W, ±10%	.12	

REFERENCE DESIGNATION INDEX

CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
R470	4758105	RESISTOR, fixed, comp, 1meg, ½W, ±10%	.12	1
R471	4758152	RESISTOR, fixed, comp, 1.5K, ½W, ±10%	.12	1
R472	4760332	RESISTOR, fixed, comp, 3.3K, 2W, ±10%	.24	1
R473	4700067	RESISTOR, var, comp, 5K, 2W, ±30%	3.00	1
R474	4760472	RESISTOR, fixed, comp, 4.7K, 2W, ±10%	.24	
R475	4758101	RESISTOR, fixed, comp, 100Ω, ½W, ±10%	.12	
R476	4758105	RESISTOR, fixed, comp, 1meg, ½W, ±10%	.12	
R477	4758152	RESISTOR, fixed, comp, 1.5K, ½W, ±10%	.12	
R478	4760332	RESISTOR, fixed, comp, 3.3K, 2W, ±10%	.24	
R479	4700067	RESISTOR, var, comp, 5K, 2W, ±30%	3.00	
R480	4760472	RESISTOR, fixed, comp, 4.7K, 2W, ±10%	.24	
R500	4758104	RESISTOR, fixed, comp, 100K, ½W, ±10%	.12	
R501	4774033	RESISTOR, fixed, WW, 3K, 10W, ±10%	1.20	1
R502	4759154	RESISTOR, fixed, comp, 150K, 1W, ±10%	.18	1
R510	4758100	RESISTOR, fixed, comp, 10Ω, ½W, ±10%	.12	1
R511	4725095	RESISTOR, fixed, prec, 73.2K, ½W, ± 1%	.60	1
R512	4725094	RESISTOR, fixed, prec, 68.1K, ½W, ± 1%	.60	1
R513	4758100	RESISTOR, fixed, comp, 10Ω, ½W, ±10%	.12	
R514	4753224	RESISTOR, fixed, comp, 220K, ½W, ± 5%	.24	1
R515	4753154	RESISTOR, fixed, comp, 150K, ½W, ± 5%	.24	1
R516	4774030	RESISTOR, fixed, WW, 1.5K, 25W, ±10%	1.60	1
R520	4758224	RESISTOR, fixed, comp, 220K, ½W, ±10%	.12	1
R521	4758474	RESISTOR, fixed, comp, 470K, ½W, ±10%	.12	
R522	4760223	RESISTOR, fixed, comp, 22K, 2W, ±10%	.24	
R530	4753274	RESISTOR, fixed, comp, 270K, ½W, ± 5%	.24	1
R531	4700031	RESISTOR, var, comp, 250K, 2W, ±20%	4.04	1
R532	4758684	RESISTOR, fixed, comp, 680K, ½W, ±10%	.12	1
R533	4758124	RESISTOR, fixed, comp, 120K, ½W, ±10%	.12	1
R534	4758104	RESISTOR, fixed, comp, 100K, ½W, ±10%	.12	
R535	4760682	RESISTOR, fixed, comp, 6.8K, 2W, ±10%	.24	1
R536	4760682	RESISTOR, fixed, comp, 6.8K, 2W, ±10%	.24	
R600	4774002	RESISTOR, fixed, WW, 0.75Ω, 5W, ± 5%	.85	1
R601	4758335	RESISTOR, fixed, comp, 3.3meg, ½W, ±10%	.12	
R602	4700012	RESISTOR, var, comp, 50K, 1W, ±30%	3.00	1

REFERENCE DESIGNATION INDEX

CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
R603	4758153	RESISTOR, fixed, comp, 15K, ½W, ±10%	.12	1
R604	4758104	RESISTOR, fixed, comp, 100K, ½W, ±10%	.12	
R605	4758104	RESISTOR, fixed, comp, 100K, ½W, ±10%	.12	
R700	4755470	RESISTOR, fixed, comp, 47Ω, 2W, ± 5%	.48	1
R701	4755161	RESISTOR, fixed, comp, 160Ω, 2W, ± 5%	.48	1
R702	4754330	RESISTOR, fixed, comp, 33Ω, 1W, ± 5%	.36	2
R703	4754330	RESISTOR, fixed, comp, 33Ω, 1W, ± 5%	.36	
R704	4754330	RESISTOR, fixed, comp, 33Ω, 1W, ± 5%	.36	
R705	4755161	RESISTOR, fixed, comp, 160Ω, 2W, ± 5%	.48	
R800	4735037	RESISTOR, fixed, MF, 270Ω, 8W, ± 5%	1.74	3
R801	4735037	RESISTOR, fixed, MF, 270Ω, 8W, ± 5%	1.74	
R802	4735037	RESISTOR, fixed, MF, 270Ω, 8W, ± 5%	1.74	
R803	4735019	RESISTOR, fixed, MF, 75Ω, 6W, ± 5%	1.74	3
R804	4735019	RESISTOR, fixed, MF, 75Ω, 6W, ± 5%	1.74	
R805	4735019	RESISTOR, fixed, MF, 75Ω, 6W, ± 5%	1.74	
R810	4735011	RESISTOR, fixed, MF, 52Ω, 6W, ± 5% 2 each	1.74	1
R811	4735004	RESISTOR, fixed, MF, 26Ω, 6W, ± 5%	1.74	1
R812	4735015	RESISTOR, fixed, MF, 70Ω, 6W, ± 5% 2 each	1.74	1
R813	4735037	RESISTOR, fixed, MF, 270Ω, 8W, ± 5%	1.74	
R814	4735037	RESISTOR, fixed, MF, 270Ω, 8W, ± 5%	1.74	
R815	4735037	RESISTOR, fixed, MF, 270Ω, 8W, ± 5%	1.74	
R816	4735011	RESISTOR, fixed, MF, 52Ω, 6W, ± 5% 2 each	1.74	
R817	4735004	RESISTOR, fixed, MF, 26Ω, 6W, ± 5%	1.74	
R818	4735015	RESISTOR, fixed, MF, 70Ω, 6W, ± 5% 2 each	1.74	
R820	4735003	RESISTOR, fixed, MF, 26Ω, 4W, ± 5%	1.35	1
R821	4735003	RESISTOR, fixed, MF, 26Ω, 4W, ± 5%	1.35	
R822	4735007	RESISTOR, fixed, MF, 35Ω, 4W, ± 5%	.70	1
R823	4735003	RESISTOR, fixed, MF, 26Ω, 4W, ± 5%	1.35	
R824	4735003	RESISTOR, fixed, MF, 26Ω, 4W, ± 5%	1.35	
R825	4735007	RESISTOR, fixed, MF, 35Ω, 4W, ± 5%	.70	
R830	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	3
R831	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R832	4753360	RESISTOR, fixed, comp, 36Ω, ½W, ± 5%	.24	2

REFERENCE DESIGNATION INDEX

CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG-SPARES
R833	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R834	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R835	4753360	RESISTOR, fixed, comp, 36Ω, ½W, ± 5%	.24	
R840	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R841	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R842	4753360	RESISTOR, fixed, comp, 36Ω, ½W, ± 5%	.24	
R843	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R844	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R845	4753360	RESISTOR, fixed, comp, 36Ω, ½W, ± 5%	.24	
R850	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R851	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R852	4753360	RESISTOR, fixed, comp, 36Ω, ½W, ± 5%	.24	
R853	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R854	4753270	RESISTOR, fixed, comp, 27Ω, ½W, ± 5%	.24	
R855	4753360	RESISTOR, fixed, comp, 36Ω, ½W, ± 5%	.24	
R856	4760181	RESISTOR, fixed, comp, 180Ω, 2W, ±10%	.24	1
R857	4753824	RESISTOR, fixed, comp, 820K, ½W, ± 5%	.24	1
R858	4700029	RESISTOR, var, comp, 100K, 2W, ±20%	4.04	1
R859	4753474	RESISTOR, fixed, comp, 470K, ½W, ± 5%	.24	
R860	4774025	RESISTOR, fixed, WW, 470Ω, 10W, ±10%	1.20	1
R861	4725095	RESISTOR, fixed, prec, 73.2K, ½W, ± 1%	.60	
R862	4700029	RESISTOR, var, comp, 100K, 2W, ±20%	4.04	
R863	4753683	RESISTOR, fixed, comp, 68K, ½W, ± 5%	.24	1
RT500	4717001	THERMISTOR, 5Ω, 10W, ±20%	2.00	3
RT501	4717001	THERMISTOR, 5Ω, 10W, ±20%	2.00	
S100	5120003	SWITCH, toggle, SPDT, Ext. Trig. Pol.	2.82	1
S110	5110012	SWITCH, rotary, Rep. Rate, Range.	7.26	1
S200	5110011	SWITCH, rotary, Delay Range	6.33	1
S300	5110011	SWITCH, rotary, Width Range	6.33	
S500	5120001	SWITCH, toggle, SPST, on-off	1.80	1
S800	5110001	SWITCH, rotary (unassembled) step attenuator -	5.52	1

REFERENCE DESIGNATION INDEX

CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
S801	5110001	SWITCH, rotary (unassembled) step attenuator +	5.52	1
T130	5650001	TRANSFORMER, Pulse	7.50	2
T210	5650001	TRANSFORMER, Pulse	7.50	
T250	5650002	TRANSFORMER, Pulse	7.50	3
T251	5650004	TRANSFORMER, Pulse	7.50	3
T260	5650004	TRANSFORMER, Pulse	7.50	
T350	5650002	TRANSFORMER, Pulse	7.50	
T360	5650002	TRANSFORMER, Pulse	7.50	
T361	5650004	TRANSFORMER, Pulse	7.50	
T500	5640021	TRANSFORMER, Power	45.00	1
T501	5670004	TRANSFORMER, Rectifier	25.00	1
T600	5610002	TRANSFORMER, Audio	5.20	1
V10	5720010	ELECTRON TUBE, 6DJ8	4.55	11
V11	5720010	ELECTRON TUBE, 6DJ8	4.55	
V12	5720010	ELECTRON TUBE, 6DJ8	4.55	
V13	5720010	ELECTRON TUBE, 6DJ8	4.55	
V20	5720010	ELECTRON TUBE, 6DJ8	4.55	
V21	5720008	ELECTRON TUBE, 6BQ7A	3.95	5
V25	5720029	ELECTRON TUBE, 7119	5.90	8
V26	5720029	ELECTRON TUBE, 7119	5.90	
V27	5720008	ELECTRON TUBE, 6BQ7A	3.95	
V30	5720010	ELECTRON TUBE, 6DJ8	4.55	
V35	5720008	ELECTRON TUBE, 6BQ7A	3.95	
V36	5720029	ELECTRON TUBE, 7119	5.90	
V37	5720029	ELECTRON TUBE, 7119	5.90	
V40	5720029	ELECTRON TUBE, 7119	5.90	

REFERENCE DESIGNATION INDEX

CIRCUIT REFERENCE	R.E.C. STOCK NUMBER	DESCRIPTION	SUGGESTED UNIT PRICE	SUG. SPARES
V45	5720011	ELECTRON TUBE, 6DQ5	7.70	3
V46	5720011	ELECTRON TUBE, 6DQ5	7.70	
V47	5720010	ELECTRON TUBE, 6DJ8	4.55	
V48	5720011	ELECTRON TUBE, 6DQ5	7.70	
V49	5720011	ELECTRON TUBE, 6DQ5	7.70	
V50	5720001	ELECTRON TUBE, 0A2	2.46	2
V51	5720006	ELECTRON TUBE, 6AS7GA	6.95	2
V52	5720017	ELECTRON TUBE, 12AX7A	2.55	2
V53	5720013	ELECTRON TUBE, 6U8A	3.30	2
V54	5720010	ELECTRON TUBE, 6DJ8	4.55	
V55	5720018	ELECTRON TUBE, 12B4A	2.35	2
V56	5720018	ELECTRON TUBE, 12B4A	2.35	
	2120001	ADAPTER, power cord, 3 wire to 2 wire	.52	1
	8501001	ASSY, switch, rep.rate, w/comps, assembled	26.44	1
	8501002	ASSY, switch, delay, w/comps, assembled	16.60	1
	8501002	ASSY, switch, width, w/comps, assembled	16.60	
	8501012	ASSY, switch, atten. - rear, w/comps. assembled	43.90	
	8501011	ASSY, switch, atten. + front, w/comps. assembled	43.90	
	8700023	ASSY, cover, top	7.50	
	8700022	ASSY, cover, bottom	4.00	
	8700021	ASSY, cover, end (two (2) per unit)	18.00	set
	2824004	POST, binding (no spacer)	.55	1
	2118003	HOLDER, req. for fuse F500	.62	1
	8700019	PILOT LAMP ASSY (green)	.64	1
	8700015	PILOT LAMP ASSY (clear)	.64	1
	2422026	KNOB, instrument, fine rep. rate, delay or width	2.65	2
	2422025	KNOB, instrument, 10db step attenuator +, rise time control -, or rise time control +	2.65	1
	2422028	KNOB, instrument, coarse rep. rate, delay or width	2.25	2
	2422027	KNOB, instrument, 10db step attenuator -, fall time control -, or fall time control +	2.25	2
	2422033	KNOB, instrument, fine attenuator	2.25	2
	2422017	KNOB, instrument, offset	.48	1
	3512001	MOTOR, fan	5.75	1
	2612002	BLADE, fan	1.25	1
	9207043	MANUAL, instruction	5.00	1
	1445009	PANEL, front, w/silk screen	14.00	
	2830024	SPACER, binding post	.15	1
	6030003	STRAIN RELIEF, req. for power cord P500	.18	1

WARRANTY

The Company warrants its equipment and materials, with exception of evacuated devices, glassware, and batteries to be free from defects in material and workmanship under normal use and service for a period of twelve months from the original date of shipment. The Company's obligation is limited to repairing or replacing any defective part or parts of such products that are returned to it.

All repairs and replacements made under this warranty are f. o. b. Company's factory shipping point or Company designated service depot. This warranty is made on condition that prompt notice of defect is given to the Company, in writing, within the warranty period, and that the Company shall have the sole right to determine whether in fact a defect exists.

This warranty does not apply to any used equipment or material, or any equipment or material which shall have been repaired or altered by other than the Company's own service engineers so as, in the Company's judgment, to adversely affect it, nor which has been subject to misuse, negligence or accident or which has been used or operated contrary to sound practice or operating instructions. Components not of Company's manufacture shall be subject to the manufacturer's warranty in lieu of this warranty.

COMPUTER MEASUREMENTS DIVISION OF NEWELL INDUSTRIES
SAN FERNANDO, CALIFORNIA 91342

		B7D
PART NO.	USED ON	MODEL
APPLICATION		

		OLD NO. WAS B7D-104	B.L.
LTR.	DATE	CO. NO.	BY

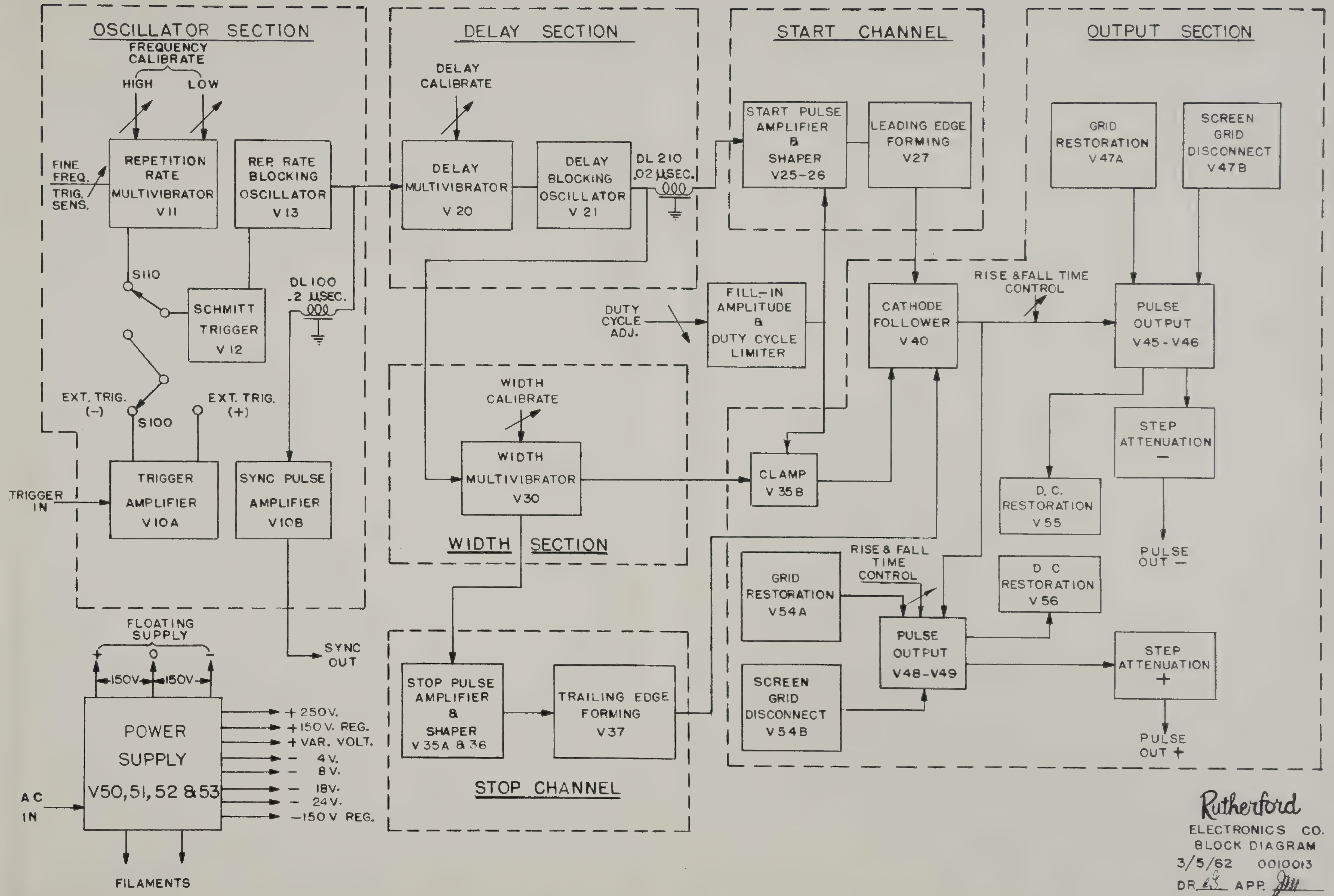
WARRANTY

The Company warrants its equipment and materials, with exception of evacuated devices, glassware, and batteries to be free from defects in material and workmanship under normal use and service for a period of twelve months from the original date of shipment. The Company's obligation is limited to repairing or replacing any defective part or parts of such products that are returned to it.

All repairs and replacements made under this warranty are f. o. b. Company's factory shipping point or Company designated service depot. This warranty is made on condition that prompt notice of defect is given to the Company, in writing, within the warranty period, and that the Company shall have the sole right to determine whether in fact a defect exists.

This warranty does not apply to any used equipment or material, or any equipment or material which shall have been repaired or altered by other than the Company's own service engineers so as, in the Company's judgment, to adversely affect it, nor which has been subject to misuse, negligence or accident or which has been used or operated contrary to sound practice or operating instructions. Components not of Company's manufacture shall be subject to the manufacturer's warranty in lieu of this warranty.

COMPUTER MEASUREMENTS DIVISION OF NEWELL INDUSTRIES
SAN FERNANDO, CALIFORNIA 91342



Rutherford
ELECTRONICS CO.
BLOCK DIAGRAM
3/5/62 0010013
DR. GS APP. JM

		B7D				
PART NO.	USED ON	MODEL			OLD NO. WAS B7D-104	B.L.
APPLICATION			LTR.	DATE	CO. NO.	BY

Model No. B7D
Drawing No. 0010009

CHANGE SHEET

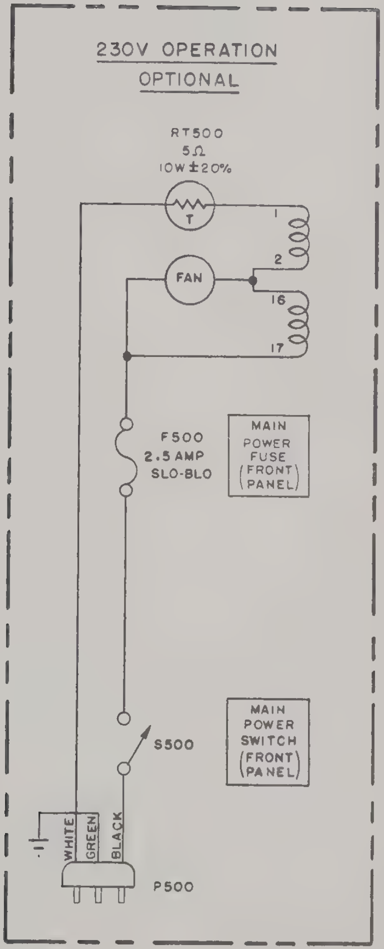
Following is a list of circuit changes referenced to the schematic diagram.

	Description of Change
	On later units C600 is changed to 60 MF, 50 V (CMC No. 4033054).

NOTES: UNLESS OTHERWISE SPECIFIED,

1 ALL FIXED RESISTORS ARE 1/2 WATT, ±10%

2 ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.

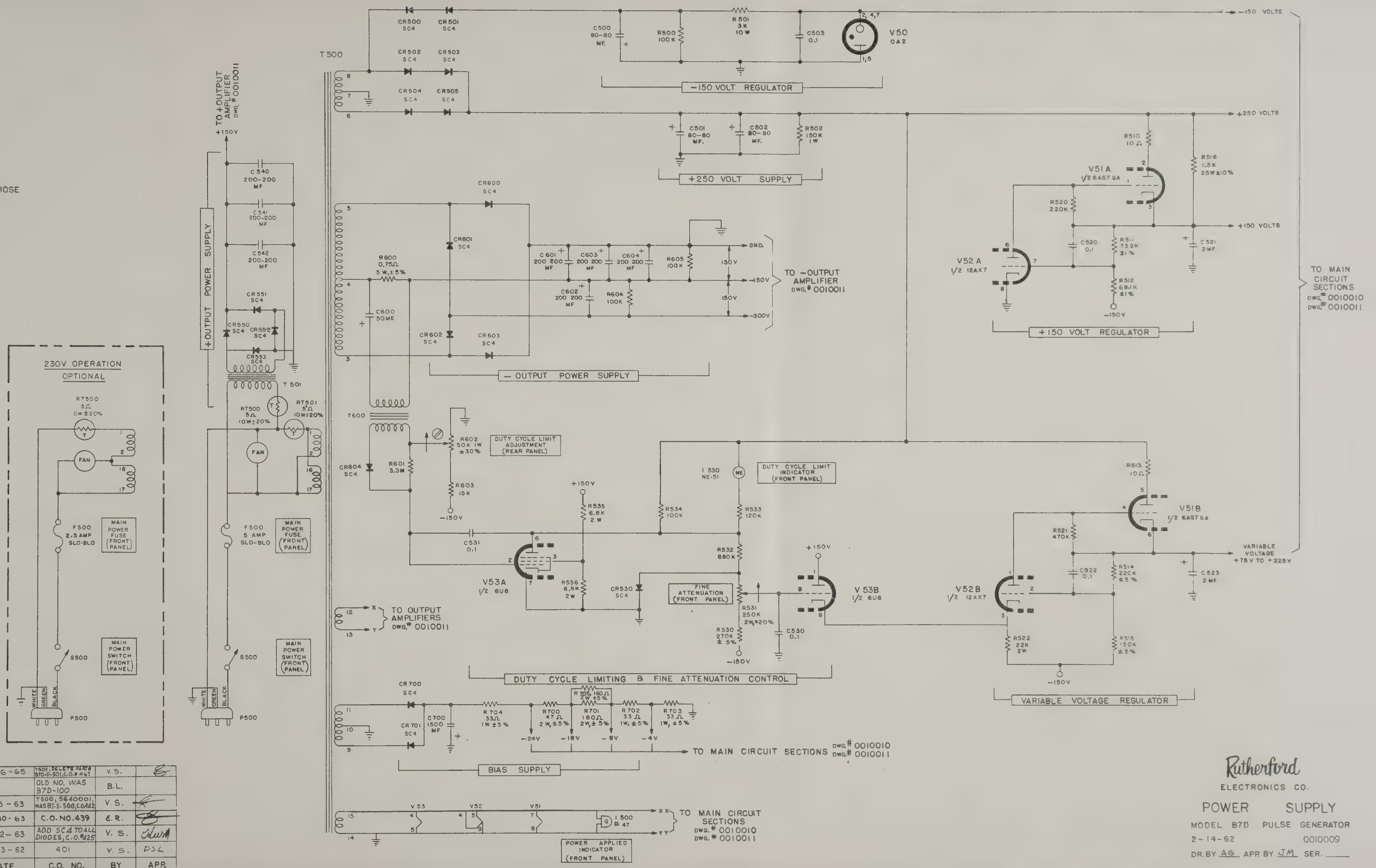


CH. LTR.	DATE	C.O. NO.	BY	APR.
E	4 - 16 - 65	T501, DELETE PART# B70-0-501, C.O.# 467	V.S.	
		OLD NO. WAS B7D-100	B.L.	
D	12 - 5 - 63	T500, 5640001, WAS B7-D-500, C.O.442	V.S.	
C	10 - 30 - 63	C.O. NO. 439	E.R.	
B	9 - 12 - 63	ADD SC4 TO ALL DIODES, C.O.#425	V.S.	
A	7 - 13 - 62	401	V.S.	DSL

NOTES: UNLESS OTHERWISE SPECIFIED,

1 ALL FIXED RESISTORS ARE 1/2 WATT, ±10%

2 ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.



E	4-16-65	T501, DELETE PART # B7D-D-501, C.O. # 467	V.S.	
		OLD NO. WAS B7D-100	B.L.	
D	12-5-63	T500, 5640001, WAS B7-D-500, C.O. 442	V.S.	
C	10-30-63	C.O. NO. 439	E.R.	
B	9-12-63	ADD SC4 TO ALL DIODES, C.O. # 425	V.S.	
A	7-13-62	401	V.S.	DSL
CH. LTR.	DATE	C.O. NO.	BY	APP.

Rutherford
ELECTRONICS CO.

POWER SUPPLY
MODEL B7D PULSE GENERATOR
2-14-62 0010009
DR. BY AG APP. BY JM SER. ____

NOTES: UNLESS OTHERWISE SPECIFIED,

1. ALL FIXED RESISTORS ARE 1/2 WATT ±10%
2. ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.

WAVEFORMS

PULSE GENERATOR SETTING:	REP. RATE	2 MC
	DELAY	0.1 µSEC
	WIDTH	0.15 µSEC
OSCILLOSCOPE SETTING:	TIME/CM	0.1 µSEC.
(TEKTRONIX TYPE 541A)	VOLTS/CM	AS SPECIFIED

F	4-16-65	R124, WAS 1.2 K C.O. NO. 467	V.S.	
E	10-2-64	ADDED FB100 & FB101, C.O. 459	E.R.	
		OLD NO. WAS B7D-101	B.L.	
B	6-14-63	R120, 3.3 K, WAS 6.8K, C.O. NO. 422	V.S.	
A	11-16-62	ADDED R118 C.O. # 406	V.S.	J.M.M.
LTR.	DATE	CHANGE	BY	APP.

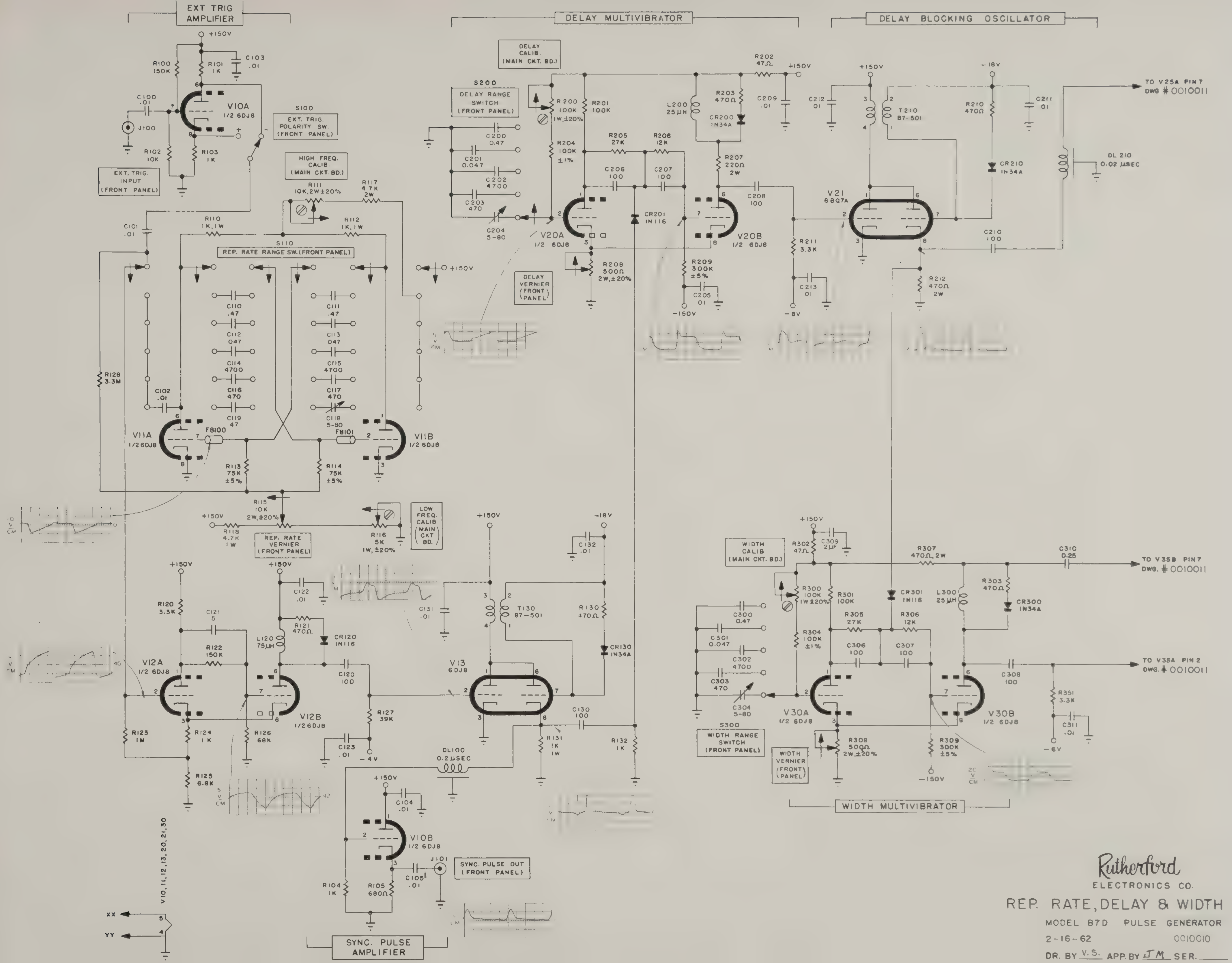
NOTES: UNLESS OTHERWISE SPECIFIED,

1. ALL FIXED RESISTORS ARE 1/2 WATT ±10%

2. ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.

WAVEFORMS

PULSE GENERATOR SETTING:	REP RATE	2 MC
	DELAY	0.1 µSEC
	WIDTH	0.15 µSEC
OSCILLOSCOPE SETTING	TIME/CM	0.1 µSEC
(TEKTRONIX TYPE 541A)	VOLTS/CM	AS SPECIFIED



F	4-16-65	R124, WAS 1.2K C.O. NO. 467	V.S.	
E	10-2-64	ADDED FB100 & FB101, C.O. 459	E.R.	
		OLD NO. WAS B7D-101	B.L.	
B	6-14-63	R120, 3.3K, WAS 6.8K, C.O. NO. 422	V.S.	
A	11-16-62	ADDED R118 C.O. # 406	V.S.	J.M.M.
LTR.	DATE	CHANGE	BY	APP.

Rutherford
ELECTRONICS CO.

REP. RATE, DELAY & WIDTH SECT.

MODEL B7D PULSE GENERATOR

2-16-62 0010010

DR. BY V.S. APP. BY J M SER. ______

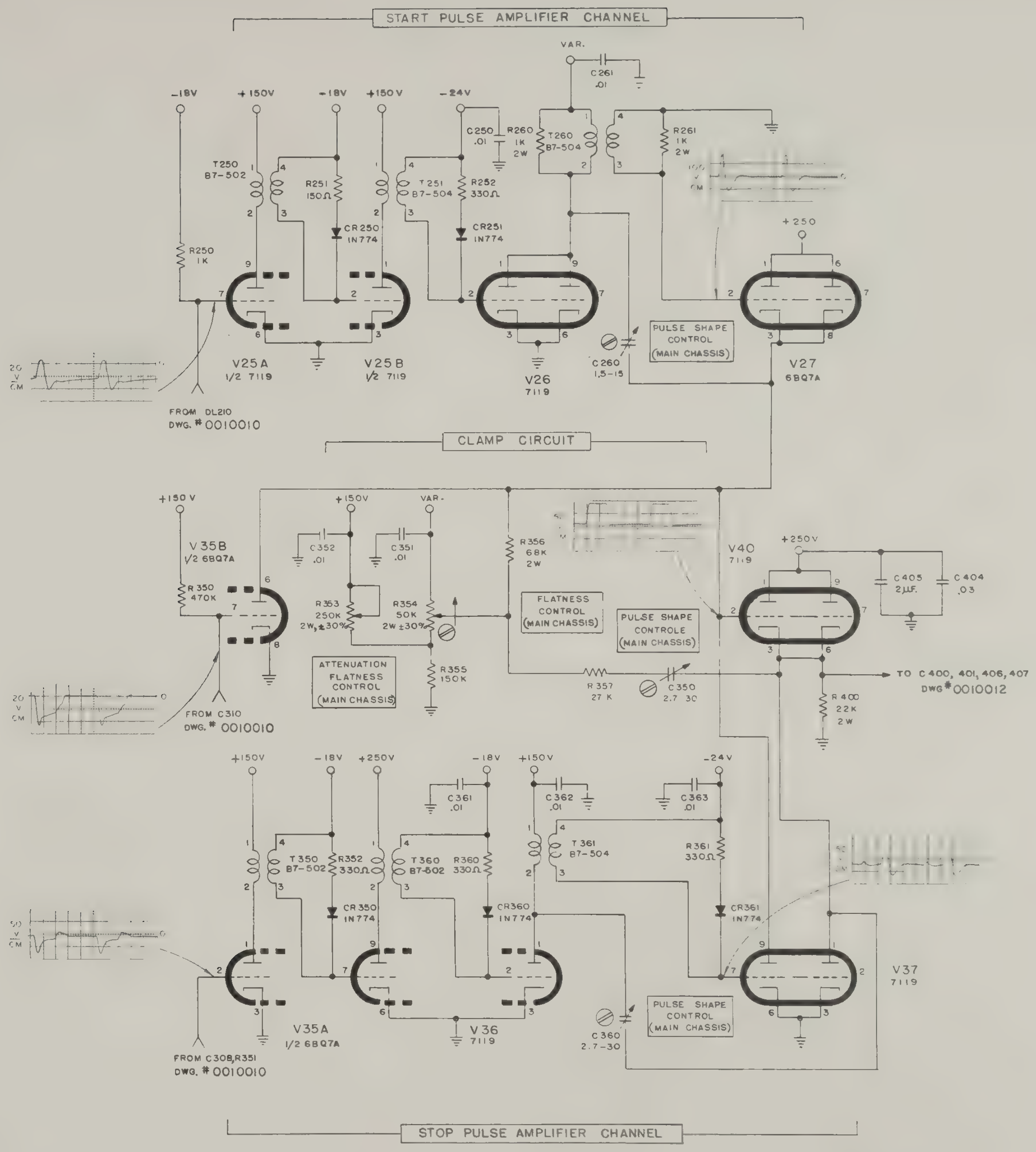
NOTES: UNLESS OTHERWISE SPECIFIED,

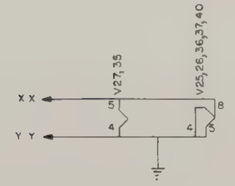
1. ALL FIXED RESISTORS ARE 1/2 WATT, ±10%

2. ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS
THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS

WAVEFORMS

PULSE GENERATOR SETTING.	REP RATE	2 MC
	DELAY	0.1 μSEC
	WIDTH	0.15 μSEC
OSCILLOSCOPE SETTING:	TIME/CM	0.1 μSEC
(TEKTRONIX TYPE 541A)	VOLTS/CM	AS SPECIFIED





CH LTR.	DATE	C.O. NO.	BY	APP.
D	4-16-65	C260 WAS 1.5-15, C.O.467	V.S.	
—		OLD NO. WAS B7D-102	B.L.	
C	11-14-63	R357 27K, WAS 10K, C.O. #441	V.S	
B	2-15-63	C350 & C360 2.7-30, WAS 4-30 C.O. # 412	V.S.	
A	7-13-62	401	V.S.	DSL

Rutherford
ELECTRONICS CO.

PULSE FORMING SECT.
MODEL B7D PULSE GENERATOR
2/16/62 0010011
DR. BY A.G. APP. BY JM SER. ______

NOTES: UNLESS OTHERWISE SPECIFIED,

1. ALL FIXED RESISTORS ARE 1/2 WATT, ±10%
2. ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.
3. STEP ATTENUATOR SWITCH, S800 & S801, SHOWN IN THE (0) DB. ATTENUATION POSITION.

WAVEFORMS

PULSE GENERATOR SETTING.	REP. RATE	2 MC
	DELAY	0.1 µSEC
	WIDTH	0.15 µSEC
OSCILLOSCOPE SETTING	TIME/CM	0.1 µSEC
(TEKTRONIX TYPE 541A)	VOLTS/CM	AS SPECIFIED

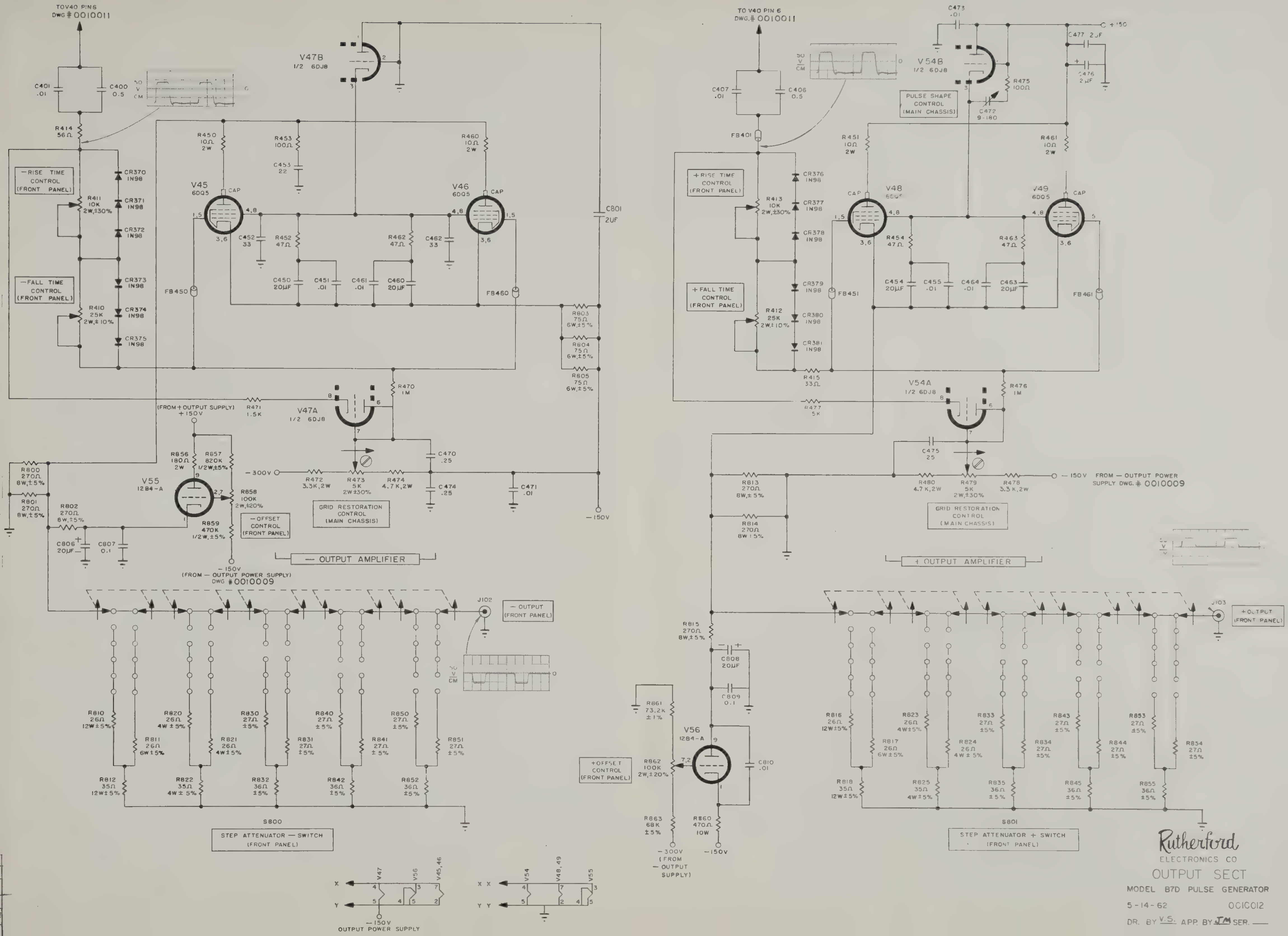
		OLD NO. WAS B7D-103	B.L.	
C	1-3-64	R410 & R412 ±10%, WAS ±30%, C.O. NO. 444	V.S.	
B	10-30-63	REMOVED C804, 2 µF. ADDED C477, 2 µF R472 & R478, 3.3K WAS 4.7K, R474 & R480, 4.7K WAS 3.3K, C.O. NO. 439	E.R.	
A	9-13-63	DELETED C805, C. O. NO. 426	V.S.	
SYM	DATE	CHANGE	BY	APP.

NOTES: UNLESS OTHERWISE SPECIFIED,

1. ALL FIXED RESISTORS ARE 1/2 WATT, ±10%
2. ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.
3. STEP ATTENUATOR SWITCH, S800 & S801, SHOWN IN THE (0) DB. ATTENUATION POSITION.

WAVEFORMS

PULSE GENERATOR SETTING	REP RATE	2 MC
	DELAY	0.1 µSEC
	WIDTH	0 15 µSEC
OSCILLOSCOPE SETTING	TIME/CM	0.1 µSEC
(TEKTRONIX TYPE 541A)	VOLTS/CM	AS SPECIFIED



		OLD NO. WAS B7D-103	B.L.	
C	1-3-64	R410 & R412 ±10%, WAS ±30%, C.O. NO. 444	V.S.	
B	10-30-63	REMOVED C804, 2µF. ADDED C477, 2µF R472 & R478, 3.3K WAS 4.7K, R474 & R480, 4.7K WAS 3.3K, C.O. NO. 439	E.R.	
A	9-13-63	DELETED C805, C. O. NO. 426	V.S.	
SYM	DATE	CHANGE	BY	APP.

Rutherford
ELECTRONICS CO
OUTPUT SECT
MODEL B7D PULSE GENERATOR
5-14-62 0C1C012
DR. BY V.S. APP. BY JM SER. ____

MAY 1970

CONDENSED CATALOG

COUNTERS
PULSE GENERATORS
TIME DELAY GENERATORS
TARGET SIMULATORS

PRINTED IN U.S.A. • EEM FILE — SEC 2900 • 5M • 470

CMC

COUNTERS

ALL-SILICON SOLID-STATE SERIES 600

The 600 Series features reliable, all-silicon, solid-state instruments that offer direct frequency measurement to 20 MHz, with prescaling to 225 MHz, with heterodyning to 3.3 GHz, plus the measurement of period, multiple period, average, frequency ratio, time interval, and totalizing, with both preset functions and portability available — all at a minimum cost.

CMC's 600 series are the first counters built with all silicon semiconductors for higher reliability, superior temperature stability. Maximum frequency ranges of 2.5,15, 20 and 225 MHz. Simplified design techniques and advanced "Mother Board" circuitry reduce components by 10 per cent over competitive models. Temperature operation —20 to +65°C standard, —30 to +75°C available. All silicon memory (display storage), a standard feature, is not subject to slow response and upper temperature limitations of photoconductor memory circuits.

MODEL 608

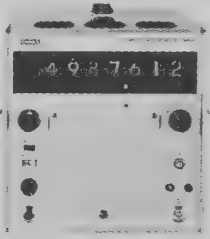
Measures frequency and period, determines frequency ratio and totalizes. Frequency, period and frequency ratio measurement ranges: 2 Hz to 15 MHz. Period average and multiple ratio: 1, 10 and 100. In-line long-life biquinary display. Five decades are standard, a sixth is optional.

MODEL 609

Measures frequency, period, multiple period average, frequency ratio, time interval, and totalizes. Frequency measurement range: 0 to 5 MHz. Period: 0 to 1 MHz. Multiple period average measurement from 0 to 20 MHz, from 10^0 to 10^7 periods in decade steps. 1 MHz crystal time base; stability ±2 parts in 10^7 per month. Six decade in-line biquinary display, automatically positioned decimal point.

MODEL 614

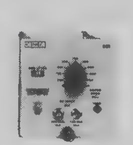
Preset Multi-function Counter extends applications to normalizing and multiplication by any preselected constant. Gate time presets to any interval from 10 μsec to 100 seconds. Gate time presets by remote selection. Direct displays as mph, rpm, ms, per N periods, etc. 614 also measures frequency and period and totalizes. Frequency range: 2 Hz to 2.5 MHz. Period and frequency ratio ranges: 2 Hz to 500 kHz. Preset count circuitry operates dependably at frequencies through 300 kHz–up to three times as fast as other variable gate time counters. 100 kHz crystal time base; stability ± 2 parts in 10^6 per week. Standard five decade in-line biquinary display (sixth optional) with automatically positioned decimal point.



MODEL 616

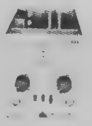
Model 616 provides low-cost direct frequency measurement from 10 Hz to 225 MHz by means of a unique prescaler built into the instrument. It can be rack-mounted. All-silicon semiconductor circuitry assures dependable operation over wide temperature ranges. 1 MHz crystal time base; stability ± 2 parts in 10^7 per month. Seven decade in-line display is standard — eighth decade optional. Standard automatic decimal and display storage.

MODEL 631



Model 631, turret-type, positive switching 100 MHz to 1.3 GHz Heterodyne Converter.

MODEL 633



Model 633, 1 μsec resolution Time Interval Plug-in with range from 1 μsec to 10 sec.

MODEL 635

Model 635, continuous tuning, 200 MHz to 3.3 GHz Heterodyne Converter.

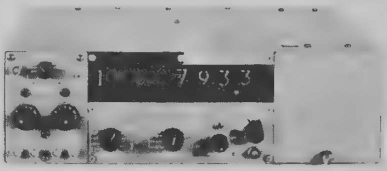
SOLID-STATE MILITARY COUNTERS

5-MHz COUNTER

MODEL 687

Model 687 is a 5 MHz fully militarized counter that measures frequency, period, multiple period average, frequency ratio, time interval and totalizes. Meets MIL-E-16400 including temperature, humidity and vibration specs.

100-MHz COUNTER



MODEL 880

Model 880 is the first solid-state counter fully militarized to meet Mil Specs. It measures frequency, period, multiple period average, frequency ratio, ratio average, time interval with internal and external clock, and totalizes; scales input frequency in decade steps; provides standard frequency outputs. If you want the safety of a counter providing full Mil Specs reliability at a price surprisingly close to a commercial counter, then check these specs: 0 to 100 MHz frequency range; oscillator stability of 1 part in 10^9; meets or exceeds MIL-E-16400, including applicable temperature, humidity, vibration, shock, and RFI specs; built-in time interval measurement. Eight decade in-line display. Militarized plug-ins available (see below).

PLUG-INS FOR MILITARIZED 880

MODEL 884

MODEL 884

Heterodyne Converter, turret-type, positive-switching, 100 MHz to 555 MHz, acceptance tested to MIL-E-16400, MIL-S-901, MIL-I-16910.

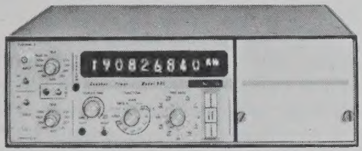
MODEL 887

Video Amplifier increases gain of Model 880 thirty times.

CMC COUNTERS

IC SERIES 900

The 200-MHz Model 901 Universal Counter-Timer and the 15-MHz Model 905 Frequency Meter were the first instruments to be introduced in CMC's completely new series of integrated-circuit counters. Now four new compact instruments in the 905 Family have been added to this expanding IC series: the Model 915 TIM, the Model 925 Totalizer, the Model 912 Preset Counter, and the Model 913 Dual Preset Counter.



MODEL 901

UNIVERSAL COUNTER-TIMER

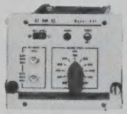
The Model 901 is a state-of-the-art instrument. It is the industry's first, true, 200-MHz, universal counter-timer capable of achieving its range without prescaling, heterodyning, or using plug-ins . . . while also offering as part of its main-frame capability the measurement of frequency, period, multiple period average, time interval, ratio, multiple ratio averaging, totalizing, scaling, and the measurement of time interval from an external standard . . . plus a heterodyning capability for gigahertz operation.

Gate times are 1 μsec to 100 seconds in decade steps. A special feature of the display control is a fast reset to 10 μsec to accommodate those requiring maximum data gathering abilities. Input sensitivity of the 901 is 10mV for both A and B amplifiers.

The readout has nine decades with automatically positioned decimal point, large readout tube with units symbols, and an overflow lamp. Printer output in the form of BCD in the 1-2-4-8 code is a standard feature. Remote programming of the entire front panel controls, except trigger levels and attenuators, is an optional feature. Time Interval mode offers resolution to 10 nanoseconds. Gate output, useful in determination of the amplifier trigger points in the Time Interval mode, is a standard feature of the 901.

FREQUENCY EXTENDER PLUG-INS

MODEL 931



MODEL 931

Turret type, positive switching 100 MHz to 1.3 GHz Heterodyne Converter. Sensitivity is 50 mV across its entire range.

MODEL 935

Continuous tuning 100 MHz to 3.3 GHz Heterodyne Converter. Sensitivity is 50 mV across its entire range.

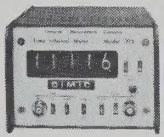
MODEL 933

Video Amplifier increases gain of Model 901 thirty times.

SERIES 900 COMPACT INSTRUMENTS

MODEL 905
15-MHz FREQUENCY METER

The Model 905 Frequency Meter is a low-cost 15-MHz counter that is priced considerably lower than comparable competitive instruments. Although low-cost, it provides quality performance and is contained in a high-quality package that features a tip-up stand for easy visibility in bench work. It can also be rack mounted. Measuring only 4″ x 5″ x 8½″, the 905 provides direct frequency measurement from DC to 15 MHz. It features a 1-MHz crystal oscillator time base with a stability of ±2 parts in 10^6 per month, and a five-decade in-line display is standard with display storage and automatically positioned decimal point. Wt. 3½ lb.

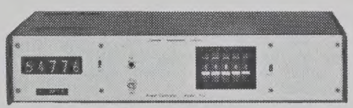


MODEL 915
TIME INTERVAL METER

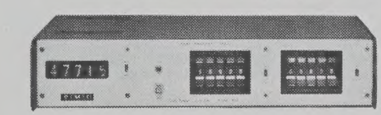
A low-cost instrument that features a 1-MHz temperature-compensated crystal oscillator . . . triggers on positive or negative going pulses . . . can be operated in either a 1 μs or 1 ms mode, with a range from 0 to 99,999. Starts on the A-input and stops on the B-input, and permits reset even during the measurement operation. Same dimensions as and fully compatible with CMC's Model 905 Frequency Meter.

MODEL 925
ELECTRONIC TOTALIZER

Frequency range, from dc to 1-MHz, or dc to 100 Hz (internally switch selectable) with totalizing count from 0 to 99,999. Trigger level is automatic, and a pushbutton switch on the front panel resets the count to "0". Same dimensions as the 905 and fully compatible with the other compact instruments in this line.



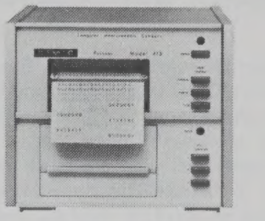
MODEL 912 PRESET COUNTER



MODEL 913 DUAL PRESET COUNTER

Both models operate in either a "Limit Mode" or "Recycle Mode" with a frequency range (selectable by internal switch) of either 0 to 100 Hz or 0 to 10 KHz. In the "Limit Mode" "output" is held at the preset number until reset manually, while continuing to count: and in the "Recycle Mode" the counters hold the "pulse relay output" at the preset number, then reset to "0" and automatically resume counting. The Model 913 is equipped with a second bank of 5 preset switches, a second control switch so that there is independent control for each switch bank. Both units completely compatible with the other CMC compact instruments, but come in 16.8″ widths for standard rack mounting.

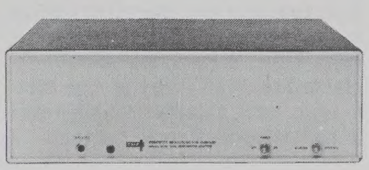
NEW LOW-COST DIGITAL PRINTER



MODEL 415

LOW-COST, DATA LOGGING PRINTER FEATURES IC DESIGN AND SUPERB MECHANISM

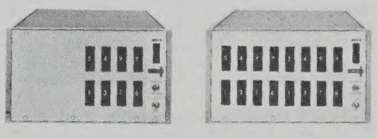
The new Model 415 Digital Printer employs IC design and utilizes IC sockets for accurate reliable performance and easy maintenance. Its mechanical printing mechanism is good for more than 5,000,000 cycles without an adjustment, is replaceable in the field, and provides the legibility of an electric typewriter. From 7 to 21 columns of line capacity are offered, and red/black printing with color selection by numerical field is provided . . . also floating decimal point, zero suppression, "print command" control over 3-input channels, and a remote control option. Speed is 3 lines-per-second, and printing stock is paper tape or fan-fold. The 415 measures 8½″w X 7½″h X 17½″d.



MODEL 403

SOLID-STATE TAPE PERFORATOR ADAPTER

Model 403 couples counters with 1-2-4-8 BCD output to the Tally Series 420 Paper Tape Perforator. Compatible with all CMC solid-state counters having standard digital printer output plug, and modifiable to accept other manufacturer's equipment. Accessory output allows simultaneous operation of digital printer in parallel with Tally 420. Up to 6 decades provided (8 optional). Accepts 60 characters per second. Punch command —4V to —12V pulse, 50 μsec wide (min.), into 10,000 ohms.



MODEL 404

SOLID-STATE GO, NO-GO COMPARATOR

Model 404 compares a binary coded decimal number, obtained from printer output receptacle of a counter with two selected preset numbers in the comparator for go, no-go operation. Provides visual display in "HI", "LO", and "IN" limit lights as well as contact closure outputs for control purposes. Half-rack size permits dual mounting. Weighs only 17 lbs. and uses just 45 watts power. Four decade preset standard, 8 optional. Remote presetting of limits optional

CMC

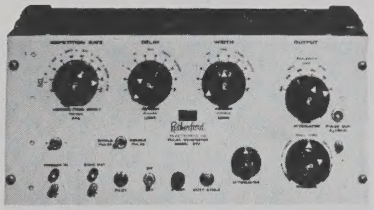
PULSE GENERATORS, TIME DELAY GENERATORS, AND TARGET SIMULATORS

PULSE AND TIME DELAY GENERATORS

Down through the years, the Rutherford/CMC instrument lines have led the industry. Here are just a few of the "firsts" that have earned CMC its enviable reputation for producing time-delay and pulse generators that are industry standards:

- *First jitter-free analog-type time delay generator
- *First pulse generator with a 100-KHz rep rate
- *First pulse generator with a 1-MHz rep rate and an 8-nsec rise time

Today, these same famous CMC lines include solid-state time-delay generators offering delays from 0 to 1 sec in 100 nsec increments, including a fail-safe model for use in explosive testing—plus a line of pulse generators that includes both portable and standard laboratory instruments offering repetition rates from 20 Hz to 20 MHz, variable rise and fall times to less than 5 nsec, and a uniform high level of accuracy and performance.

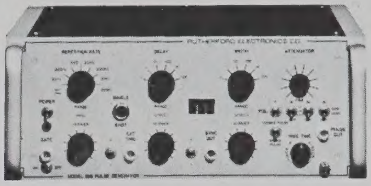


BASIC PULSE GENERATOR

B-7B is a general purpose instrument with repetition rate to 2 MHz and 50V into 50 ohms. Variable rise/fall time control.

B-7D has all specifications of B-7B and simultaneous positive and negative output pulses; separate and independent rise/fall time controls.

B-7F has all B-7B features plus: 2 Hz repetition rate; separate rise/fall time controls; and double pulse output.



MODEL B-14
MODEL B-15
MODEL B-16

PORTABLE PULSE GENERATORS

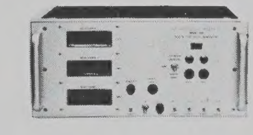
Model B-14 is a low cost, portable unit with repetition rate of 20 Hz to 2 MHz. Delay is 0 to 10 msec. Amplitude is 15V into 1k, 8V into 50 ohms. Pulse width of 60 nsec to 10 msec. Rise/fall time is less than 10 nsec fixed.

B-15 has same rise/fall time, delay, and pulse width. Also offers a repetition rate of 5 Hz to 5 MHz.

B-16 offers repetition rate of 20 Hz to 20 MHz. Variable rise/fall times of less than 5 nsec to greater than 200 nsec. Pulse width 15 nsec to 10 msec. Amplitude 10V. Single or pulse pair operation.

Rack mount available for B-14, -15, -16.

TIME DELAY GENERATORS



MODEL A-10
MODEL A-11
MODEL A-12

SOLID-STATE DELAY GENERATORS

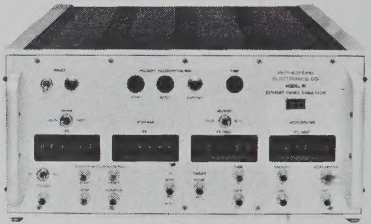
A-10 has time delays 0 to 1 sec in 100 nsec increments. Accuracy 0.001% of delay. Jitter less than 1 nsec. Amplitude 10V. Rise time 15 nsec.

A-11 has same features as A-10 with exception of amplitude, 6V and rise time 10 nsec.

A-12 was designed for fail-safe operation in explosives testing or other tests where premature triggering might destroy information. Amplitude, 70V; rise time, 100 nsec.

DYNAMIC TARGET SIMULATOR

The Model 301 is a truly unique off-the-shelf instrument that aids in the design, evaluation, checking, and calibration of tracking systems. It does this by producing artificial targets which can be easily and accurately set to various ranges and which can be dynamically moved at various velocities and/or accelerations. It features all solid-state digital logic... low jitter, high accuracy, high stability... 1-foot target resolution... and is available for portability or rack mounting.



MODEL 301

DYNAMIC TARGET SIMULATOR

Model 301 is a moving target simulator. It is applicable to tracking radars, weapons control systems, or sonar for calibration, production checkout, or operator training.

The standard Model 301 has a target Range from 0 to 1,000,000 feet in one foot increments with 0.1% of setting accuracy. It has a target Velocity from 0.0 to 100,000.0 feet/second in 0.1 foot/second increments with 0.005% of setting accuracy. Target Acceleration can be set from 0.00 to 10,000.00 feet/second/second in 0.01 foot/second/second increments with 0.005% of setting accuracy.

Special versions of the Digital Target Simulator are available with increased accuracies. 301's have also been built with remote-programming capabilities and ruggedized to meet MIL specifications.

Your local CMC representative will demonstrate these products on your premises at your convenience. Call him or call CMC direct.

All prices f.o.b. factory

COMPUTER MEASUREMENTS COMPANY
CMC
A DIVISION OF NEWELL INDUSTRIES

12970 Bradley Avenue
San Fernando, California 91342
Phone (213) 367-2161
TWX 910-496-1487

This list of specifications is not an offer. Since we cannot control our source(s) of component(s) supply, we cannot guarantee availability of these specifications at published prices.

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